Approaches to Reducing Cardiovascular Disease Risk and Stress Effects in Underserved Populations

A DISSERTATION
SUBMITTED TO THE FACULTY OF
UNIVERSITY OF MINNESOTA
BY

Dawn Renee Witt

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Ruth Lindquist, PhD, RN, ACNS-BC, FAHA, FAAN, Advisor
Diane Treat-Jacobson, PhD, RN, FAAN, Co-Advisor

June 2014

Acknowledgements

I would like to thank my academic advisor Ruth Lindquist for her support, encouragement and mentorship throughout my time in the doctoral program and particularly in the writing of this dissertation. Her enthusiasm and encouragement have been invaluable over the past few years. I would also like to thank my co-advisor Diane-Treat Jacobson for her guidance and expertise as I conducted this research. Kay Savik provided exceptional statistical advice, patience and encouragement throughout this process, and this truly would not have been possible without her. Dr. Russell Luepker provided valuable advice on the broader scope of population health research and I am grateful for his thoughtful questions and guidance on how to approach this project. Jackie Boucher offered support, encouragement and provided helpful context on the HONU project. I also received statistical guidance from Arthur Sillah, and editing and proofreading expertise from Ashley Lyle and Meg Clemens. I would also like to thank the Minneapolis Heart Institute Foundation and Allina Health for granting me the opportunity to be part of the Heart of New Ulm Project.

Dedication

This dissertation is dedicated to my parents, Elvin & Norma.

Abstract

Background: While the past decade has shown a decrease in mortality and morbidity due to cardiovascular disease (CVD), it remains the leading cause of death for both men and women in the US. The burden of CVD has been demonstrated to disproportionately affect underserved populations. The course and development of CVD has been shown to be affected by modifiable risk factors such as physical inactivity, poor nutrition, smoking, and the psychosocial risk factors of depression, anxiety and stress.

Objective: This study sought to explore approaches to reducing cardiovascular disease risk and stress effects in underserved populations; Latina and African American women, and individuals living in a rural population in New Ulm, MN.

Method: The first purpose of this dissertation was to describe the results from a secondary data analysis utilizing 2009 and 2011 screening data from the Heart of New Ulm Project (HONU) project. Secondly, we present the results of our recently published literature review that explored the use of motivational interviewing as a technique to reduce CVD risk among African American and Latina women.

Results: Women reported higher levels of stress and had higher levels of C-reactive protein (CRP) compared to men at baseline. Men had a significantly higher diastolic blood pressure (DBP) and systolic blood pressure (SBP) and reported more physical activity (PA) and a greater history of heart disease compared to women at baseline. No significant difference was found between change in stress level and changes in SBP, PA or CRP for men; however change in stress level was associated with a change in SBP for women. The covariates of body mass index (BMI) and age demonstrated

significant associations with the outcome variables for women; among men, smoking, BMI and education had significant association on the outcome measures.

None of the community health promotion events were shown to have a direct effect on any of the outcome variables of interest. The female-specific, SBP model demonstrated a borderline significant indirect effect of stress in 2009 *via PA* and stress in 2011 on SBP in 2011. The female specific, less than moderate PA (< mod PA) and the greater than moderate PA (> mod PA) models both demonstrated significant indirect effects of stress in 2009 *via PA* and stress in 2011 on < mod PA and > mod PA, respectively. Additionally, stress for females in 2011 was associated with increased CRP in 2011. The male-specific models demonstrated a significant indirect effect of stress in 2009 on > mod PA and < mod PA in 2011 *via PA* and stress in 2011, respectively. We found that the use of MI in populations of African American and Latina women demonstrated that MI can be an effective technique to reduce CV risk (Witt et al., 2012). It was shown that positive effects were attained in increasing fruit and vegetable consumption, decreasing hypertension/lowering SBP, achieving weight loss goals, and improving knowledge of CVD risk modification among those receiving motivational interviewing.

Conclusion: The results from this study provide compelling evidence that future work exploring the effects of stress on modifiable risk factors for CVD in underserved populations, particularly physical activity and blood pressure is warranted. The work presented here demonstrate that while the effects of stress on the outcomes of interest were small, more intensive, targeted interventions with individuals experiencing elevated

stress may produce more substantive effects in mediating the relationship between stress and physical activity and blood pressure. The small effect sizes found in this study may be due to in part, to the lack of intensity of the interventions delivered via HONU programming and may also be attributed to the fact that the HONU interventions did not specifically have a stress reduction component. Use of behavioral interventions such as motivational interviewing have demonstrated efficacy in supporting positive behavior change and could be used as an adjunct component in CVD risk reduction interventions at the population level, particularly among underserved populations. The key is to deliver the intervention consistently and in a culturally appropriate manner.

Recommendations for Future Research

Behavior change programs delivered at the population level and future CVD prevention programming in settings such as New Ulm should continue to build upon the lessons learned from community based projects like HONU, the Minnesota Heart Health Program (MHHP), Pawtucket, and the North Karelia Project. Additionally, more work is needed to determine how to support long-lasting behavior change using techniques such as motivational interviewing and ensure that the modifiable risk factors for CVD are addressed. Targeted interventions that address stress among those experiencing the highest levels of stress may prove to have the most impact in mitigating the effect of stress on other modifiable behaviors.

As the results from behavior change interventions have demonstrated, uptake of healthy lifestyle and health promoting behaviors and adhering and maintaining those behaviors are a universal problem, regardless of race and sex. Use of behavioral

interventions such as motivational interviewing have demonstrated efficacy in supporting and sustaining positive behavior change and could be used as an adjunct component in CVD risk reduction interventions at the population level, particularly among underserved populations. Developing and implementing targeted interventions that clearly address stress reduction among those at risk for CVD is warranted.

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Chapter 1: Introduction

While the past decade has shown a decrease in mortality and morbidity due to cardiovascular disease (CVD), it remains the leading cause of death for both men and women in the US (Roger et al., 2012). Additionally, the burden of CVD has been demonstrated to disproportionately affect underserved populations (Kurian and Cardarrelli 2007; Kanjilal et al., 2006; Mensah, Mokdad, Ford, Greenlund & Croft, 2005; Stuart-Shor, Berra, Kamau & Kumanyika, 2012). Underserved populations have been described as groups of individuals who experience marginalization for numerous factors including race/ethnicity, those living in resource-limited rural settings or individuals living in urban settings within resource challenged communities (Bryant et al., 2010).

Three underserved groups experiencing health disparities are the focus of this dissertation; Latina and African American women, and individuals living in a rural population in New Ulm, MN. While these three groups are clearly defined by race and geographic location, they all carry a disproportionate risk for CVD. There is a rising prevalence of overweight, obesity, diabetes, and low levels of physical activity among these three populations (Go et al., 2013). Individuals living in rural communities experience a higher risk associated with CVD compared to those living in urban areas (Colleran, Richards & Schafer, 2007) and African American and Latina women experience the greatest proportion of CVD burden when compared to white women (Roger et al., 2011).

Modifiable CVD Risk Factors

The course and development of CVD has been shown to be affected by

modifiable risk factors such as physical inactivity, poor nutrition, smoking, and the psychosocial risk factors of depression, anxiety and stress (Rosengren et al., 2004; Yusef et al., 2004; Rosanski et al., 2005). Stress has only recently been recognized as a potential CVD risk factor. Of the more than 25,000 study participants in the INTERHEART Study, those who reported high levels of stress had a 2.5 times greater risk of having a myocardial infarction compared to those with lower stress levels (Rosengren et al., 2004).

The mechanism by which stress has an apparent effect on disease development, disease progression and health outcomes is unclear. It is also unknown how, and to what extent, stress is a barrier to engaging in positive health-related practices, such as physical activity and healthful eating. However, it is clear that behavior change interventions that target the modifiable risk factors for CVD have been effective in reducing CVD risk (Eckel et al., 2013). One such technique to improve behavior change is motivational interviewing.

Motivational Interviewing

Motivational interviewing can be described as a patient-directed approach to facilitate behavior change. The counselor engages in empathetic listening and helps guide the patient to recognize their ambivalence about behavior change (Miller & Rollnick, 2002). Motivational interviewing is a framework that has shown promise in numerous populations to facilitate behavior change (Miller & Rollnick, 2002).

There is an ample body of literature that has demonstrated that motivational interviewing can be effective in reducing CVD risk (Thompson et al., 2011). A 2010 scientific statement from The American Heart Association confirmed that motivational

interviewing has a strong evidence-based approach and can improve adherence to many different types of behavioral interventions, including physical activity and healthful eating (Artinian et al., 2010). Motivational interviewing has also been used in underserved populations that experience health disparities to reduce cardiovascular risk (Corsino et al., 2012; Ogedegbe et al., 2007; Resnicow et al., 2005; Villablanca et al. 2009; Witt et al., 2013). Another underserved population with high level of CVD risk is individuals living in rural populations.

Hearts Beat Back: The Heart of New Ulm Project (HONU)

The HONU project is a multi-year population-based prevention demonstration project designed to reduce the incidence of myocardial infarctions (MI) and reduce the overall prevalence of disease and risk factors for coronary artery disease (CAD) at the population level in New Ulm, Minnesota, a rural population in southern Minnesota (Boucher et al., 2008). The HONU project comprises of a multi-faceted approach to reduce CVD risk with interventions that include a wide array of programming that address the food environment, physical activity, stress and nutrition. These interventions target the community through lifestyle behavior change programming utilizing motivational interviewing in the existing community prevention services in the local clinics and hospital, health-related social media, changes to the food environment, worksites interventions and in the community at large (VanWormer et al., 2012).

Summary

The HONU project provides an opportunity to examine how this community-based demonstration project has sought to reduce CVD risk and stress through

community-wide behavioral interventions that utilize components of motivational interviewing.

Purpose

The first purpose of this dissertation was to describe the results from a secondary data analysis utilizing 2009 and 2011 screening data from the HONU Project. Secondly, the results of the author's recently published literature review that explored the use of motivational interviewing as a technique to reduce CVD risk among African American and Latina women are presented in manuscript form. The dissertation aims related to the HONU analysis and the literature review are described below.

Dissertation Aims

Aim 1. Describe the sex-specific baseline characteristics of stress in the Heart of New Ulm (HONU) cohort who were screened in 2009, and identify the relationship between baseline measures of stress and blood pressure (BP), high sensitivity C-reactive protein (CRP) and physical activity (PA).

Aim 2. Identify if changes in stress levels at baseline are associated with changes in PA, BP and CRP in the cohort screened twice, and determine if there are sex-specific differences.

Aim 3. Determine what effect, if any, HONU program participation has on the relationship between the independent variable of stress and the dependent variables of BP, CRP and PA, and determine if there were any sex-specific differences in the outcome variables.

Aim 4. Describe the results of a literature review that explored the use of motivational interviewing to reduce CVD risk among two populations that experience health disparities; African American and Latina women.

Significance

The work presented in this dissertation will add to the body of research that explores the effects of stress on the outcomes of interest: blood pressure, physical activity and C-reactive protein in a large sample of adults in a rural population. This work will provide an examination of the effectiveness of the HONU programming as a mediator between stress and the outcomes of interest. Additionally, the literature review on reducing CVD risk among African American and Latina women presented in this dissertation adds to the limited body of research of behavioral interventions to reduce CVD risk targeting this group of women.

Organization of Dissertation

This dissertation is organized into five chapters. Chapter 1 provides an introduction to, an overview of the dissertation and its aims. Chapter 2 comprises a manuscript that explores the sex-specific, baseline characteristics of stress in the HONU cohort who were screened at baseline. In this manuscript the relationships between baseline measures of stress and BP, CRP and PA are described. Further, the manuscript examines the effects of changes in perceived stress at baseline on changes in measures of PA, BP and CRP in 2011, and compares these changes by sex. In Chapter 3, the mediating effects of participation in community-wide programs between stress and the outcomes of BP, PA and CRP were explored, and whether this mediation differed by sex

were analyzed. Chapter 4 comprises a literature review that explored the use of motivational interviewing as a technique to reduce CVD risk among African American and Latina women that we have recently published. Chapter 5 reviews the major findings from this dissertational body of research, and provides recommendations for future research necessary to reduce the burden of CVD risk among underserved populations experiencing health disparities.

Chapter 2: Manuscript One

This chapter explores Aim 1 and Aim 2 of the dissertation. The purpose of Aim 1 was to describe the sex-specific baseline characteristics of stress, systolic blood pressure (BP), Hs-CRP (CRP) and physical activity (PA) in the population of individuals in New Ulm that attended screening events in 2009 and 2011. The purpose of Aim 2 was to describe the sex-specific differences in the changes in stress on changes in PA, BP and CRP in the cohort screened twice, in 2009 and 2011.

Title: Identification of Gender Differences in Stress and Outcomes of Physical Activity, C-Reactive Protein and Blood Pressure in a Community-Based Screening Project

*(*To be submitted to CDC- Preventing Chronic Disease Journal)*

First Author: Dawn Witt, MPH, Minneapolis Heart Institute Foundation, Minneapolis, MN

Authors: Dawn Witt, MPH, Minneapolis Heart Institute Foundation; Ruth Lindquist, PhD, University of Minnesota; Diane Treat-Jacobson, PhD, University of Minnesota; Kay Savik, MS, University of Minnesota; Arthur Sillah, MPH, Allina Health, Minneapolis, MN; Jackie L. Boucher, MS, RD, Minneapolis Heart Institute Foundation, Minneapolis; Russell V. Luepker, MD, MS, University of Minnesota.

Correspondence to Dawn Witt, Minneapolis Heart Institute Foundation

Fax: 612.863.3801

Telephone: 612.863.6504

Email: dwitt@mhif.org

Disclosures: None.

Introduction: The Heart of New Ulm Project (HONU) is a multi-year population based prevention demonstration project designed to reduce the incidence of myocardial infarctions (MI) and reduce the overall prevalence of disease and risk factors for CAD at the population level in New Ulm, Minnesota. The purpose of this paper was 3-fold. First, the sex-specific characteristics of stress, C-reactive protein (CRP), blood pressure (BP) and physical activity (PA) at baseline were examined; second, the sex-specific differences between change in measures of stress on changes in measures of CRP, BP and PA was assessed; and third, the relationships between covariates of interest and the outcome measures CRP, BP and PA were explored.

Method: The main analytic sample for this study included 1,452 participants who attended both 2009 and 2011 HONU screening events. Total and gender specific linear regression models were used to assess stress change on CRP and BP, and multinomial regression models were used to assess change in stress level on change on PA level between 2009 and 2011.

Results: Women reported higher levels of stress and had higher levels of CRP compared to men at baseline. Men had a significantly higher diastolic blood pressure (DBP) and systolic blood pressure (SBP) and reported more PA and a greater history of heart disease compared to women at baseline. No significant difference was found between change in stress level and changes in SBP, PA or CRP for men. No significant difference was found between change in stress level and changes in PA or CRP for women however, change in stress levels was significantly associated with change in SBP for women. The covariates of BMI and age demonstrated significant associations with the

outcome variables for women; among men, smoking, BMI and education had significant association on the outcome measures.

Conclusion: Change in stress level was not associated with changes in CRP, BP or SBP for men, but change in stress did have a small effect on change in SBP for women. Although this effect was modest, future research is warranted to examine the effects of targeted programs of stress reduction on groups of women experiencing high levels of stress.

Key words: stress, blood pressure, CRP, physical activity**,** cardiovascular disease, population health

Introduction

It has been determined that lifestyle factors such as smoking, poor nutrition, lack of exercise, and psychosocial risk factors such stress, anxiety and depression can affect the course and development of cardiovascular disease (CVD)(1-3). Of these lifestyle factors, stress has been identified as a potentially significant, modifiable contributor and predictor of CVD (1,2,4). Stress can be conceptually defined as the inability to adapt to environmental demands, which may be chronic or acute, positive or negative (5).

The INTERHEART Study revealed that of the more than 25,000 study participants, those reporting elevated stress levels were 2.5 times more likely to have a myocardial infarction (MI) compared to those reporting lower stress levels (1). Further, results from the Women's Health Study(6) indicated that women with high levels of job related stress were twice as likely to have an MI and had a 43% greater risk of undergoing a cardiac procedure. Men participating in MRFIT (Multiple Risk Factor

Intervention Trial) who were followed for nine years demonstrated similar results; those who had dissolution of marriage and experienced chronic work stress had increased risk of cardiovascular mortality (7).

The mechanism by which stress has an apparent effect on health outcomes and disease development and progression is unknown, and there is currently a gap in the existing literature that explains the exact mechanisms of stress, how stress affects other beneficial health practices, and what detrimental effects stress has on the body. To explore the effects of stress on CVD, this study explored sex-specific differences of three outcome variables of interest- blood pressure, CRP and physical activity using data from community-based screenings, in a multi-year research and demonstration project. Additionally, we explored the effect of other covariates such as BMI, smoking, age and educational attainment of the outcome variables between men and women.

Methods

Population

The analysis for this study employ data from the Hearts Beat Back: The Heart of New Ulm Project (HONU) 2009 and 2011 screening data. HONU is a multi-year population based prevention demonstration project designed to reduce the incidence of MI and reduce the overall prevalence of disease and risk factors for coronary artery disease CAD at the population level in New Ulm, Minnesota (8).

The HONU Project was developed to deliver services and programs in the New Ulm area that enhance existing health care programs in the community. Community-wide screenings were implemented to identify CVD risk in the New Ulm zip code (56073),

located in a rural area of southwestern Minnesota. HONU was developed and informed by previous community-based interventions such as the Minnesota Heart Health Program (9, 10), Stanford Five-City Project (11), Pawtucket Heart Health Program (12) and the North Karelia Project (13).

The initial screenings were conducted in 2009, with follow-up screening exams in 2011. Individuals 18 years or older were eligible to participate in screenings. Screening sites were held at various community venues (e.g., worksites, community centers, churches) (14). The final sample from the 2009 and 2011 HONU screening data include individuals ages 40-79. The main analytic sample for this analysis includes the 3,123 participants who attended the 2009 screening events, and the subset of 1,452 participants who returned in 2011 for a follow-up screening.

HONU Screenings

The HONU screening events held in 2009 and 2011 were held at worksites, community centers and churches and were free and open to individuals 18 years or older. Both screenings held in 2009 and 2011 were conducted similarly, and both screenings were conducted periodically over the course of approximately 8 months. Prior to screenings, all participants were asked to fast 12 hours. As part of the screening, all participants were registered and consented, and completed one questionnaire which included a health history and a behavioral risk factor survey. Additionally, anthropometric measures (i.e., height, weight, waist circumference and blood pressure), and venipuncture were collected. The screening appointments took approximately 20-30 minutes. Following the screening, participants received a personal risk factor report and

met with a registered dietitian or health educator to discuss risk factors identified in the screening process. Additionally, the screening participants also received guidance on improving health and were provided additional resources and educational opportunities in the community. The Allina Institutional Review Board approved the protocol and all procedures for the parent study and this subsequent secondary data analysis. Comprehensive reports of the HONU Project and the data collected from the community cardiovascular risk screenings are described elsewhere (8,14).

The present work utilized a panel design for the analysis. Individuals who were screened for CVD risk factors in both 2009 and 2011 were included in the analyses. The primary outcome measures for these analyses were changes in levels of PA, BP and CRP from 2009 to 2011.

Independent Measures

Physical activity. Self-reported responses of physical activity were given by participants utilizing the screening tool developed for the Behavioral Risk Factor Surveillance System (15). This tool has been demonstrated to be valid and reliable. Four items indicating vigorous and moderate minutes/week were reported in moderate equivalent units; categorized as sufficient (≥150) or insufficient (< 150) per national guidelines. Vigorous activity minutes were doubled to provide an estimate of moderate intensity physical activity and added to self-reported moderate activity minutes to create a measure of total physical activity at a moderate intensity. The PA variable was divided into three groups: moderate PA which equals 150-300 minutes of moderate PA; greater than moderate which equals 301 or more minutes of moderate PA and less than moderate,

which captured individuals who reported less than 150 minutes of moderate PA per week (16).

High sensitivity C-reactive protein (CRP). Following a request of 12-hour fast using standard Allina medical laboratory blood collection and processing procedures (http://www.abbottnorthwestern.com/ahs/allinalabs.nsf/page/manual), one 5 mL tube of blood, equivalent to about 1 teaspoon, was drawn for these tests. All blood measures were assessed via venipuncture. Blood tubes were centrifuged for 10 minutes soon after collection and aliquots analyzed at New Ulm Medical Center laboratory; categorized per standard Allina range limits (http://www.abbottnorthwestern.com/ahs/allinalabs.nsf/page/RefRChem12010.pdf/$FILE/RefRChem12010.pdf). CRP was analyzed as a continuous variable.

Blood pressure. BP was measured three times by trained staff after three minutes of rest and each taken one minute apart in a seated position using the Sun Tech 247, using an automatic sphygmomanometer with a properly sized cuff (17). These procedures and measurements were adapted from the Canadian Hypertension Society guidelines categorized as hypertension ($\geq 140/90$), prehypertension ($120–139/80–89$), or normal ($< 120/80$). The mean of the last two BP measures was used for analytical purposes.

Dependent Measure

Stress. Self-reported stress levels were measured using the Perceived Stress Scale 4 (PSS-4); the PSS-4 has firmly established validity and reliability (18,19). The PSS-4 includes four items that capture feelings and perceptions about the magnitude of life

challenges, as well as personal stress management capabilities over the previous month. The questions included in the PSS-4 are as follows: **"**In the last month, how often have you felt that you were unable to control the important things in your life?"; In the last month, how often have you felt confident about your ability to handle personal problems?"; In the last month, how often have you felt that things were going your way?"; and "In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?" Response categories are (1) never, (2), almost never, (3) sometimes, (4) fairly often, and (5) very often. These items are coded numerically from 0 to 4. The stress variable was treated continuously for this analysis.

Statistical Analysis

Percentages and means and standard deviations of selected baseline measures (2009) were used to describe the study sample stratified by gender and rescreening status in 2011(for those who attended the 2009 screenings only, compared to those who attended screening events in 2009 and 2011). However, for the non-normally distributed physical activity measure at baseline, median and interquartile range was reported. A 2-sample t-test was used to test for differences in mean and Pearson chi-square test for categorical measures. Non-normally distributed interval data, such as physical activity, were compared between gender and rescreening status in 2011 using a Mann-Whitney U test. To answer the research question regarding how changes in the stress levels from baseline (2009) are associated with changes in CRP, DBP and SBP, a multiple linear regression model was conducted with change in stress as the primary predictor variable and several baseline covariates simultaneously. Baseline covariates were chosen based on

their previously known or clinically suspected association with stress and CRP, PA and SBP respectively. These included, stress levels, age, sex, education level, smoking status, body mass index (BMI), personal history of diabetes or heart disease, and antihypertensive medication use at baseline. To account for the wide range and non-normally distributed change scores for the PA variable, multinomial regression modeling was conducted after categorization to < moderate, moderate and > moderate PA as defined above. Total and gender specific estimates models were conducted. All statistical analyses were conducted using SPSS statistical packages version 20.0 (SPSS Inc., Chicago, IL) with statistical significance set at 2-sided alpha value of 0.05.

Results

In 2009, 3120 participants in the target population were screened, of whom 1,452 (46.5%) returned for the 2011 screening. Table 2.1 describes differences in the sample population of those screened in 2009 only (n = 1,668) and those who returned in 2011 (N=1452). Participants screened in both 2009 and 2011 were more likely to be younger (mean(SD)), 56.3(SD, 9.6) vs 57.1(SD, 10.5), p = .027), female (63% vs 53%, p = <0.001), to report more physical activity (250 min/week vs 225 min/week), have a decreased average SBP 127.7 (SD, 15.2) vs 129.8 (SD, 16.3), p = <0.001), and decreased average BMI 29.1 (SD, 5.8) vs 29.8 (SD, 5.8) p = <0.001). Those who only attended the 2009 screening had higher self-reported prevalence of diabetes (9% vs 5%, p = <0.001), and a history of heart disease (18% vs. 15%, p = 0.03). The screening sample was predominantly white (97%). The data set used in this analysis was quite complete; 94%

of cases had no missing data, 5% of cases were missing one variable and 1% of cases were missing 2 variables.

Table 2.1

Comparison of 2009 Screening Participants and Screening Participants at Both Time Points

Demographic	Screened in 2009 only N = 1,668 (53.5%)	Screened in 2009 and 2011 N = 1452 (46.5%)	p-values
Age, mean (sd) in years	57.1 (10.5)	56.3 (9.6)	0.03
Female, %	53	63	<0.001
History of diabetes %	9	5	<0.001
History of heart disease %	18	15	0.03
Behavioral Risk Factors			
Total physical activity minutes, median +/- iqr	225 (380)	250 (370)	0.05
Stress levels (0_16), mean +/- sd	3.8 (2.9)	3.7 (2.8)	0.72
Biometric Risk Factors			
Blood pressure (mean in mmhg +/- sd)			
SBP	129.8 (16.3)	127.7(15.2)	<0.001
DBP	79.4 (10.1)	79.0 (10.0)	0.31
BMI	29.8 (5.8)	29.1 (6.1)	<0.001
Hs-CRP, mg/l, mean (sd)	3.21 (5.74)	3.04 (4.82)	0.37

Note. This table presents a comparison of those who only attended the screening event in 2009 to those who attended screening events in 2009 and 2011. [a]Meets physical activity standard of 150 minutes/week at a moderate intensity. MmHg = millimeter of mercury; SBP = systolic blood pressure; DBP = diastolic blood pressure; Hs-CRP = high sensitivity C-reactive protein; BMI = body mass index.

Sex-specific Differences at Baseline

Table 2.2 presents the baseline sex-specific differences in outcome variables of interest for screening participants who were screened in 2009 and returned in 2011. Overall, women were less educated and more women had never smoked compared to men. Men reported significantly more moderate physical activity than women and had a significantly greater history of heart disease compared to women. Women had higher reported perceived stress when compared to men. Men reported a significantly higher SBP and DBP compared to women, and women were shown to have significantly higher CRP levels when compared to men.

Table 2.2

Sex-specific Baseline Characteristics of Screening Participants from 2009 who Returned in 2011

	Total	Females	Males	
	n = 1452	n = 916 (63%)	n = 536 (36%)	p-value
Age (mean +/- sd), y	56.3 (9.6)	56.0 ± 9.5	56.8 ± 9.7	.13
Education, %				
GED or less	30.3	32.8	25.8	
Some college or technical training	34.6	36.7	31.1	
College degree or higher	35.1	30.5	43	<0.001
History of diabetes %	5.1	5.0	5.3	.85
History of heart disease %	6.1	4.3	9.4	<0.001
Cigarette Smoking				
Current	6.0	5.8	6.2	
Former	30.7	26.5	37.8	
Never	63.4	67.7	56.0	<0.001
Total moderate PA in mins ± iqr [a]	250 ± 370	245 ± 350	260 ± 415	0.03
Perceived Stress (0-16 points scale), mean ± sd	3.7 ± 2.8	3.9 ± 2.9	3.5 ± 2.5	0.02
Medication for hypertension	28.7	27.3	31.0	0.14
Blood Pressure (mean in mmHg ± sd)				
SBP	127.7 ± 15.2	126.6 ± 15.9	129.5 ± 14.0	<0.001
DBP	79.0 ± 10.0	77.6 ± 9.9	81.4 ± 9.6	<0.001
Hs-CRP (mean ± sd, mg/l)	3.0 ± 4.8	3.2 ± 4.1	2.7 ± 5.8	0.04

Note. [a]Meets physical activity standard of 150 minutes/week at a moderate intensity. iqr = interquartile range; SBP = systolic blood pressure; DBP = diastolic blood pressure; MmHg = millimeter of mercury; Hs-CRP = high sensitivity C-reactive protein.

Effects of Change in Stress on Outcome Measures

CRP. Table 2.3 provides details from the sex-specific linear regressions models conducted to explore the effects of the change in stress on the change in CRP, SBP and DBP. Change in self-reported stress from 2009-2011 did not affect CRP for men or women. The covariate of BMI was significantly associated with CRP for both women and men. For every one unit increase in BMI, CRP increased .04 points for men and .03 points for women. If a man reported being a current smoker in 2009, his CRP was .36 points higher in 2011.

SBP and DBP. Change in self-reported stress did not affect DBP or SBP for men. However, for women, each one unit increase in stress had a corresponding increase in SBP of .33 points. The covariate of age affected SBP for both women and men. For every one year increase in age, SBP increased .09 points for men and increased .16 points for women. Men with a college education had a SBP 2.7 points lower on average compared to men without a college degree. BMI affected SBP for both women and men. For every one unit increase in BMI, CRP increased .39 points for men and .37 points for women. BMI also affected DBP for men; for every one unit increase in BMI, DBP increased by .13 points.

Physical activity. Table 2.4 provides details from the sex-specific multinomial logistic regression model exploring the change in PA based on 3 categories (< moderate activity, moderate activity, > moderate activity). Moderate physical activity was the reference group for this model. The 2009 exercise intensity group that both men and women were in was the strongest predictor of the group they were in at follow-up, in

2011. Men and women who were in the <moderate group in 2009 were 2.8 and 3.0 times, respectively, more likely to stay in the < moderate group rather than increase to the moderate exercise group. Men and women in the > moderate group were 3.9 and 4.6 times, respectively, to stay in that group than move down to the moderate group. An increase in stress level from 2009 to 2011 made it 8% less likely that a woman would be in the > moderate group.

For every increase of 1 BMI unit, a man was 1.1 times more likely to be in the < moderate group. For women, increase in age, increase in stress level and a diagnosis of heart disease increased the odds they would be in the < moderate group.

Table 2.3

Linear Regression Models for SBP, DBP and CRP

SBP	Total Sample		Men		Women	
	β(se(β))	p-value	β(se(β))	p-value	β(se(β))	p-value
Age in 2009	.13(.20)	<.001	.09(.03)	.004	.16(.03)	<.001
SBP 2009	-.45(.02)	<.001	-.54(.03)	<.001	-.42(.03)	<.001
Education: 2 categories	-1.8(.60)	.003	-2.7(.95)	.004	-.80(.77)	.30
DM 2009	.06(1.1)	.96	-.18(1.8)	.92	.02(1.5)	.99
Heart dx 2009	-1.1(1.2)	.34	-2.4(1.6)	.15	.33(1.7)	.85
Stress 2009	.13(.12)	.27	.11(.19)	.56	.15(.14)	.30
BMI 2009	.38(.05)	<.001	.39(.09)	<.001	.37(.06)	<.001
Cigs former 2009	.30(.63)	.64	2.1(1.0)	.04	-.40(.81)	.62
Cigs current 2009	-.07(.99)	.95	-.17(1.6)	.91	.31(1.3)	.81
Delta stress	**.20(.13)**	**.11**	**-.04(.21)**	**.86**	**.33(.16)**	**.04**
DBP	Total Sample		Men		Women	
	β(se(β))	p-value	β(se(β))	p-value	β(se(β))	p-value
Age in 2009	-.02(.01)	.16	-.02(.02)	.35	-.02(.02)	.33
DBP 2009	-.40(.02)	<.001	-.37(.03)	<.001	-.41(.03)	<.001
Education: 2 categories	-.44(.40)	.28	-.29(.62)	.64	-.51(.53)	.34
DM 2009	-1.9(.78)	.01	-2.1(1.2)	.08	-1.9(1.0)	.07
Heart dx 2009	-.90(.79)	.25	-1.3(1.1)	.23	-.181(1.2)	.88
Stress 2009	.03(.08)	.70	.03(.13)	.80	.03(.10)	.75
BMI 2009	.17(.03)	<.001	.13(.06)	.03	.18(.04)	<.001
Cigs former 2009	-.35(.42)	.42	-.42(.67)	.53	-.19(.56)	.74
Cigs current 2009	-.48(.67)	.47	.01(1.0)	.99	-.76(.89)	.40

Delta stress	**.11(.09)**	**.21**	**.06(.14)**	**.65**	**.12(.11)**	**.26**

Table 2.3

Linear Regression Models for SBP, DBP and CRP (continued)

CRP	Total Sample		Men		Women	
	β(se(β))	p-value	β(se(β))	p-value	β(se(β))	p-value
Age in 2009	-.001(.002)	.60	.006(.003)	.11	-.005(.003)	.09
CRP 2009	-.14(.008)	<.001	-.21(.02)	<.001	-.13(.01)	<.001
Education: 2 categories	.04(.06)	.50	.15(.09)	.09	-.05(.08)	.53
DM 2009	-.16(.14)	.23	-.03(.20)	.88	-.24(.18)	.19
Heart dx 2009	.0003(.13)	.99	-.17(.15)	.29	.08(.19)	.69
Stress 2009	.02(.01)	.10	.002(.02)	.93	.03(.02)	.08
BMI 2009	.03(.005)	<.001	.04(.009)	<.001	.03(.007)	<.001
Cigs former 2009	-.02(.07)	.73	.15(.10)	.13	-.13(.09)	.13
Cigs current 2009	.29(.12)	.02	.36(.18)	.04	.27(.16)	.10
Delta stress	**.02(.01)**	**.19**	**.01(.02)**	**.51**	**.02(.02)**	**.34**

Note: SBP= systolic blood pressure; DBP = diastolic blood pressure; CRP = high sensitivity C-reactive protein; DM = Diabetes Mellitus; Heart dx = heart disease diagnosis; Education: 2 categories = some college or more, or, no college. Cigs = cigarette smoker.

Table 2.4

Multinomial Logistic Regression for Physical Activity

group	Total Sample				Males				Females			
	< moderate		> moderate		< moderate		> moderate		< moderate		> moderate	
	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value	OR(95%CI)	p-value
BMI 2009	1.03(1.004,1.06)	.02	1.0(.98, 1.02)	.98	1.1(1.01, 1.1)	.02	1.02(.98, 1.07)	.37	1.02(.99,1.05)	.16	.99(.97, 1.02)	.56
Age	1.02(1.01,1.03)	.004	.99(.99, 1.005)	.37	1.00(.98, 1.02)	.90	.99(.98, 1.02)	.82	1.02(1.01, 1.04)	.001	.99(.98, 1.00)	.22
PSS 2009	1.08(1.02, 1.2)	.01	.96(.91, 1.02)	.19	1.03(.93, 1.1)	.55	.95(.87, 1.04)	.28	1.1(1.03, 1.2)	.004	.97(.91, 1.04)	.37
Δ Stress	1.05(.98, 1.1)	.19	.92(.87, .98)	.01	1.07(.96, 1.2)	.25	.95(.86, 1.04)	.27	1.04(.96, 1.1)	.33	.92(.86, .98)	.02
Heart Disease	1.3(.54,2.3)	.42	1.04(.57, 1.9)	.90	.69(.29, 1.6)	.40	.64(.31, 1.3)	.21	2.6(1.06, 6.5)	.04	1.8(.74, 4.6)	.19
Diabetes Mellitus	1.01(.56, 1.9)	.97	.71(.38, 1.3)	.27	1.8(.69, 4.9)	.22	.71(.27, 1.9)	.49	.71(.32, 1.5)	.39	.73(.35, 1.5)	.39
College	1.1(.82, 1.5)	.49	.89(.68, 1.2)	.28	1.1(.70, 1.9)	.60	.97(.64, 1.5)	.87	1.2(.80, 1.7)	.45	.81(.59, 1.1)	.18
Former smoker 2009	.98(.70, 1.4)	.90	1.01(.76, 1.3)	.93	1.4(.82, 2.4)	.22	1.1(.70, 1.7)	.68	.78(.52, 1.2)	.25	.93(.67, 1.3)	.69
Current smoker 2009	1.7(.91, 3.1)	.10	1.2 (.72, 2.1)	.44	1.3(.51, 3.5)	.56	.91(.41, 2.02)	.82	1.9(.93, 4.1)	.08	1.5(.75, 2.9)	.25
PA in 2009												
< moderate	3.0(2.1, 4.2)	<.001	.75(.54, 1.05)	.10	2.8(1.6, 5.0)	<.001	.58(.34, 1.01)	.06	3.0(2.0, 4.5)	<.001	.86(.59, 1.3)	.43
>moderate	.77(.50, 1.2)	.25	4.3(3.2, 5.8)	<.001	.76(.39, 1.5)	.41	3.9(2.4, 6.2)	<.001	.76(.44, 1.3)	.31	4.6(3.2, 6.6)	<.001

Note. Group = values at baseline; BMI = body mass index; PSS 2009 = perceived stress score at baseline; Δ Stress= change in stress from 2009 to 2011; CRP= high sensitivity C-reactive protein, Education: 2 categories = some college or more or, no college. Physical activity 3 categories = < moderate activity (149 minutes or less), moderate activity (150-300 minutes), > moderate activity (301 minutes or more). Moderate physical activity is the reference group.

Discussion

The findings from this study demonstrated that change in levels of stress were not associated with corresponding changes in PA, CRP or BP for men. However, changes in stress were associated with SBP for women. Significant, sex-specific differences in baseline stress level, CRP and DBP and SBP were shown. Women had higher reported perceived stress when compared to men. The Nurse's Health Study showed that women who were caregivers had an increased risk of incident coronary heart disease (CHD) and mortality; the results indicated those who experienced a high caregiver-burden stress level had an increased risk for developing CHD when compared to women without similar caregiving responsibilities (20). Orth-Gomer and colleagues reported that women who had previously experienced an MI and women with high levels of marital stress were more likely to experience a second cardiac event compared to counterparts with less marital stress (21). Likewise, women with ischemic heart disease commonly report experiencing considerable stress (22, 23).

This study sample of women was also shown to have significantly higher CRP levels when compared to men. This finding is similar to results of a study exploring distribution of CRP values in the US, which found that nationally, CRP levels are higher in women (24). Elevated CRP levels are a measure and indicator of the processes associated with inflammation and development of CVD (25). Chronic and acute stressful experiences or negative health behaviors have been shown to be associated with elevated levels of CRP (26, 27, 28) and CRP has been shown to be an active precursor in the atherosclerotic process (29) and incident ischemic heart disease (30).

In this analysis, change in self-reported stress did not affect DBP or SBP for men, however, there was a small, but significant association between change in stress on change in SBP for women in this study sample. High blood pressure is a leading risk factor for CVD and stroke and with a prevalence rate close to 30% that has remained largely unchanged over the past 10 years (31). While the relationship between acute stress and hypertension has been explored with mixed findings (32, 33), it is less clear what effect chronic, sustained stress has long term on blood pressure (34). In this analysis, the covariate of age affected SBP for both women and men. For every one year increase in age, SBP increased .09 points for men and increased .16 points for women. Men reported a significantly higher SBP and DBP compared to women. Men with a college education had a SBP 2.7 points lower on average than men without a college degree. The covariate of BMI affected SBP for both women and men. For every one unit increase in BMI, SBP went up .39 points for men and .37 points for women. BMI also affected DBP for men and women; for every one unit increase in BMI, DBP increased by .13 points for men and .18 points for women. These results reflect the findings of other studies that identify the risk of increasing SBP with weight gain, particularly among middle-aged adults (35).

The change in stress measures for women were associated with change in PA; increase in stress level from 2009 to 2011 made it 8% less likely that a woman would be in the > moderate group. Previous research has shown a similar association between physical activity and stress levels in women. In a large observational study of 12, 028 individuals, men and women who were physically active were less likely to report

dissatisfaction with life and were less likely to be affected by stress (36). Overall, programs to manage stress, increase physical activity and improve nutrition have been shown to have impact on reducing risk factors for CVD (37), improve health-related quality of life (38), and reduce the need for revascularization (39).

Limitations

Aside from the measurement of BP, the other primary outcome measures of physical activity and stress were self-reported. There are the inherent, healthy volunteer bias and methodical limitations in the HONU screenings; those who attended the follow-up screening event in 2011 generally comprised a healthier population sample at baseline compared to those who did not return. The study sample was predominantly white individuals living in a rural mid-western town also limiting the generalizability to other more geographic and racially diverse populations.

Conclusion

This study sought to describe the characteristics of stress and its effect on BP, CRP and PA among one group of rural adults. The findings from the results of the analysis exploring stress will add to the body of literature on sex differences in prevalence of stress, blood pressure, CRP and physical activity. More work is needed to understand what, if any, long-term impact of stress has on overall cardiovascular health of both men and women.

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Chapter 3: Manuscript Two

This chapter explores Aim 3 of the dissertation. This aim sought to determine what effect, if any, HONU program participation has on the relationship between the independent variable of stress and the dependent variables of BP, CRP and PA, and to determine if there were any sex-specific differences in the outcome variables.

Title: An Exploratory Path Analysis: Stress and the Mediating Effects of Program Participation on Physical Activity, Blood Pressure and Hs-CRP in a Community-Based Demonstration Project

*(*to be submitted to Research in Nursing and Health)*

Dawn R. Witt, MPH[1,2]

Kay Savik[1]

Ruth Lindquist, PhD, RN[1]

Diane Treat-Jacobson, PhD, RN[1]

Jackie L. Boucher, MS, RD[2]

Arthur Sillah, MPH[3]

Russel V. Luepker, MD, MS[4]

[1]University of Minnesota School of Nursing

[2]Minneapolis Heart Institute Foundation

[3]Allina Health, Minneapolis

[4]University of Minnesota School of Public Health

Author Note:
Dawn R. Witt, Minneapolis Heart Institute Foundation
Correspondence concerning this article should be addressed to Dawn Witt
920 East 28th Street, Suite 100, Minneapolis, MN 55407
Contact: dwitt@mhif.org

Introduction: Early detection and modification of lifestyle risk factors for cardiovascular disease (CVD) can be vital in the prevention and progression of CVD. Programs to reduce stress, increase physical activity and improve nutrition have been shown to have impact on reducing risk factors for CVD, improve health-related quality of life and reduce the need for revascularization. This secondary data analysis utilized data from the Heart of New Ulm Project (HONU), a multi-year population based prevention demonstration project in New Ulm, Minnesota.

Method: Structural equation modeling (SEM) was used to conduct multivariate analysis to assess the mediating effects of HONU program participation between stress at baseline and systolic blood pressure (SBP), high-sensitivity C-reactive protein (CRP), physical activity (PA) at follow-up. The interrelatedness between the dependent variable of stress at baseline and demographics of interest were also explored.

Results: None of the community health promotion events were shown to have a direct effect on any of the outcome variables of interest. The female-specific, SBP model demonstrated a borderline significant indirect effect of stress in 2009 *via PA* and stress in 2011 on SBP in 2011. The female specific, < mod PA and the > mod PA models both demonstrated significant indirect effects of stress in 2009 *via PA* and stress in 2011 on < mod PA and > mod PA, respectively. Additionally, stress for females in 2011 was associated with increased CRP in 2011. The male-specific models demonstrated a significant indirect effect of stress in 2009 on > mod PA and < mod PA in 2011 *via PA* and stress in 2011, respectively.

Conclusion: The association between stress levels on outcomes of CRP, PA and SBP warrants future research to explore these relationships in greater detail.

Key words: stress, BP, Hs-CRP, physical activity, rural health, population health intervention

Introduction

One in every five deaths is caused by cardiovascular disease (CVD) (Roger et al., 2012). Myocardial infarctions have been attributed to modifiable risk lifestyle risk factors, such as overweight and obesity, smoking, stress, poor nutrition, and physical inactivity (Roger et al., 2012). CVD is also associated with modifiable physiologic risk factors including high blood pressure, dyslipidemia, diabetes mellitus, and low aerobic capacity (Leon, 2009; Roger et al., 2012). Early detection and modification of these lifestyle risk factors can be vital in the prevention and progression of CVD. Programs to reduce stress, increase physical activity and improve nutrition have been shown to have an impact on reducing risk factors for CVD (Farquhar et al., 1985; Haskell et al., 1994; Koertge et al., 2008), improve health-related quality of life (Koertge et al., 2003), and reduce the need for revascularization (Lisspers et al., 2005; Ornish, 1998; Ornish et al., 1998).

We hypothesized that the effects of stress on outcomes of CRP, PA and BP would be mediated by participation in community programming interventions that were implemented as part of a multi-year research and demonstration project: The Hearts Beat Back: The Heart of New Ulm Project (HONU) (Boucher et al., 2008). Structural equation modeling (SEM) was used to conduct multivariate analysis. The interrelatedness between

the dependent variable of stress and the primary independent variables of systolic blood pressure (SBP), high sensitivity C-reactive protein (CRP), physical activity (PA), and additional covariates of interest were analyzed following the model specified a priori in Figure 3.1.

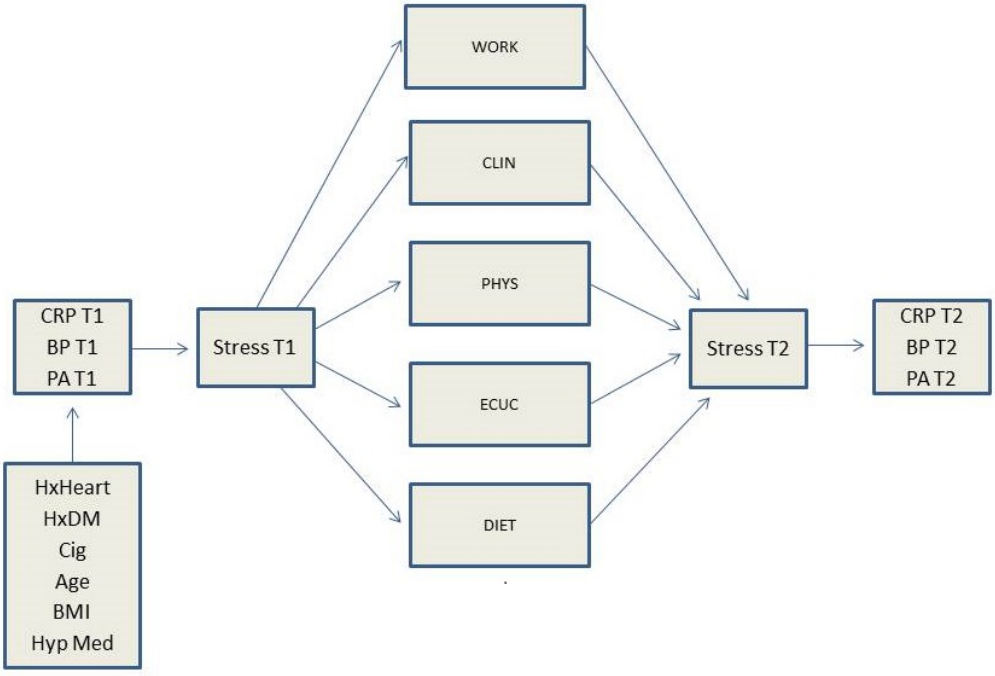

Figure 3.1. Full Mediation Model for Path Analysis. WORK = workplace interventions; CLIN = clinical interventions; PHYS = physical activity interventions; EDUC = educational interventions and DIET = dietary interventions. HxHeart = diagnosis of heart disease at baseline; HxDM = diagnosis of diabetes mellitus at baseline; BMI = body mass index at baseline; Cig = history of smoking at baseline; Hyp Med = use of hypertension medication at baseline for SBP model only; CRP T1& T2 = C-reactive protein levels at baseline and follow-up; BP T1 & T2 = systolic blood pressure at baseline and follow-up; PA T1 & T2 = physical activity at baseline.

Methods

Participants

The main analytic sample for this analysis included the 1,452 participants who attended both HONU screening events in 2009 and 2011. A brief description of the independent and independent variables, covariates of interest and mediating variables are provided below. Detailed description from the HONU Project of the data collected, comprehensive reports of the community cardiovascular screenings and the variables of interest are described in greater detail elsewhere (VanWormer et al., 2012; Boucher et al., 2008). The Allina Institutional Review Board approved the procedures of the parent study and all participants signed informed consent forms. This secondary data analysis was approved by the Allina Institutional Review Board.

Measures

Stress. The Perceived Stress Scale 4 (PSS-4) was used to measure self-reported stress. The PSS-4 has firmly established validity and reliability (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1998). The stress variable was treated as a continuous variable for these analyses.

Physical activity. Self-reported responses of physical activity were reported by participants using the Behavioral Risk Factor Surveillance System (BRFFS) screening tool (Centers for Disease Control and Prevention, 2009). The PA variable was divided into three groups for this analysis: less than moderate PA; (≤ 149 minutes of moderate PA per week); moderate PA (150-300 minutes of moderate PA per week); and greater than moderate PA (301 or more minutes of moderate PA per week).

CRP. Following request of 12-hour fast using standard Allina medical laboratory blood collection and processing procedures (www.abbottnorthwestern.com/ahs/allinalabs nsf/page/manual), one 5 mL tube of blood, equivalent to about 1 teaspoon, was drawn for this test. All samples for blood measures were collected via venipuncture. Blood tubes were centrifuged for 10 minutes soon after collection and aliquots analyzed at New Ulm Medical Center laboratory. Median values of CRP for American women are 2.5 mg/l and 1.5 mg/l for American men (Woloshin & Schwartz, 2005). CRP levels of <1 mg/l indicate a low relative risk for CVD; levels 1-3 mg/l indicate moderate relative risk and >3 mg/l indicate a high relative risk (Yeh & Willerson, 2003). CRP levels were analyzed as a continuous variable for this analysis.

Systolic blood pressure. BP was measured three times after three minutes of rest in a seated position by trained medical staff using the Sun Tech 247, an automated blood pressure measuring device, with a properly sized cuff. These procedures and measurements were adapted from the Canadian Hypertension Society (Padwal et al., 2009). The average systolic pressure of the last two BP readings was used for this analysis. Blood pressure was analyzed as a continuous variable.

Covariates

Demographic information. The baseline covariates of antihypertensive medication used, smoking status, age, body mass index (BMI), personal history of heart disease, and personal history of diabetes were used for this analysis. All demographic information was self-reported.

Mediating Variables

Program participation. The social-ecological model (SEM) provided a theoretical framework from which the HONU programs were developed- the SEM model targets risk factors at the individual, social, institutional, community and policy levels (McLeroy et al., 2003). The HONU community health promotion interventions delivered were implemented via a broad array of venues including the local New Ulm health care system, in worksites and in the community at large following the baseline screenings in 2009. Individuals completing the screening questionnaire in 2011 were given a list of the 12 HONU programs and asked to identify which programs they had participated in since the 2009 screening: the Take Five Community Health Challenge, use of a Heart Health Station to measure blood pressure, participation in a grocery store tour, participation in a worksite program, attendance at a cooking class, watched "What's Cooking New Ulm?" television show, visited the heartsbeatback.org website, attended a neighborhood lifestyle program, attended a neighborhood healthy potluck, participated in a walking club event, received the Heart of New Ulm Project e-newsletter or read the newsletter in the New Ulm Journal, or participated in HeartBeat Connections (HBC), a telemedicine, phone coaching program. For the purpose of these analyses, the 12 HONU programs were collapsed into five variables: physical activity programs (PHYS); education programs (EDUC); clinical programs (CLIN); worksite programs (WORK) and dietary programs (DIET) as presented in Table 3.1.

The HBC program and the Community Health Challenge entail far more intensive programing than the other programs (Benson et al., 2013). The HBC program is delivered

to high-risk patients that have been identified through the medical records of HONU participants. These individuals are offered one-on-one coaching with a registered dietitian or a registered nurse. This program focuses on optimizing major risk factors such as high cholesterol levels, blood pressure, nutrition, exercise, and stress. The phone coaches have all been trained in motivational interviewing (MI) techniques, and use this to support behavior change. The health coaches have the ability to initiate or titrate medications for blood pressure or and statins following approved protocols. A nurse practitioner provides oversight to all medication adjustment. Preliminary findings of the HBC program have demonstrated success; after six months of participation in HBC, enrollees significantly decreased their LDL levels compared to non-enrollees (Benson et al., 2014).

The Take Five! 2011 Community Health Challenge was initiated in February 2011 with an additional jump-start in the fall of 2011 to help HONU participants re-engage in healthy behaviors through a six-week campaign. This campaign included: a calendar of events happening in New Ulm, a tip booklet with daily weight management tips, recipe cards from EatingWell magazine, and weekly emails.

Table 3.1

Heart of New Ulm Interventions

Intervention	Implementation and Participation	Intensity	Staff delivering interventions
Educational Interventions			
Community Health Challenges	6 total Health Challenges offered to the community following broad campaign themes encouraging small changes in physical activity, nutrition, and stress management. Individual participation using program materials and emails.	6-8 week, however, participation varied by individuals	Community project manager, program operations staff and worksite manager
Clinical Intervention			
HeartBeat Connections Or, visited a heart health station	Phone coaching program targeting patients at high cardiometabolic risk but without CHD. Goals: improve use of preventive medications and lifestyle-related risks.	Varies by individual (calls occur~ every 4-6 weeks and last 15-30 minutes	Dietitians, nurses, or health care program manager.
Worksite Interventions			
Worksite behavior change programs	Behavior change programs focused on weight loss, nutrition, or physical activity.	6-8 week – level of individual or group activity varies by program	Worksite program manager or operations staff
Physical Activity Interventions			
Community Health Challenge or neighborhood walking program	Health Challenges offered encouraged small changes in physical activity, nutrition, and stress management. Individual participation using program materials and emails.	~6-8 weeks - participation varied by individual	Community project manager, program operations staff and worksite manager
Dietary Interventions			
Neighborhood healthy potluck, What's Cooking New Ulm - TV show, cooking class, grocery store tour	Cooking classes, grocery store tours, and presentations. "What's cooking New Ulm TV Show" is presented on local cable access 7 times per week with 64 new episodes in 2010 and 2011.	TV show is weekly, grocery store tours last 1 hour, cooking classes vary	Dietitians, chefs or health educators

Note: Figure adapted from Sillah et al., 2013

Statistical Analysis

Descriptive statistics were calculated for all demographic characteristics of the sample. Means and standard deviations were produced for all continuous variable and frequencies and percentages were produced for categorical variables. Data analyses were conducted to test for differences in stress levels between 2009 and 2011 (see Chapter 2 of this dissertation for a summary). The SEM model explored the mediating effect of program participation on BP, CRP and physical activity. Additional demographics of interest including antihypertensive medication used, smoking status, age, body mass index (BMI), personal history of heart disease, and personal history of diabetes were included in this analysis. The models for these path analyses were developed *a priori.*

An appropriate method to identify the mediating effects of a model can be conducted via a path analysis. A path analysis provides the ability to calculate total, indirect and direct effects between measures of interest, while concurrently solving an entire set of regression equations. Path analysis also allows for tests of mediation effects using either product terms or multiple group comparisons (Baron & Kenny, 1986; Preacher & Hayes, 2008). The software used for this multivariate path analysis is Mplus Version 6 (Muthén & Muthén, 2010). Overall model fit was assessed using global fit indices including the Comparative Fit Index (CFI) which has a desired result of ≥ .95; the Tucker-Lewis Index (TLI) with ideal fit statistics of ≥.95 for continuous data and ≥.96 for categorical data; the Standardized Root Mean Square Residual (SRMR) with a 0 indicating a perfect fit, ≤ .08 considered good; and the Root Mean Squared Error of Approximation (RMSEA) with desired range of <.08 (Schreiber et al., 2006). CRP and

BP were interval data modeled with linear regression, PA was categorized as the three categories mentioned above and were modeled with ordinal logistic regression functions. In the case of the ordinal logistic regression, beta coefficients were converted to odds ratios using the formula e^{β}.

Results

A total of six, sex-specific, separate path analyses were conducted for the outcome variables of CRP, PA and SBP. The five community programming interventions of physical activity programs; education programs; clinical programs; worksite programs and dietary programs were included as hypothesized mediators between stress at time one (2009) and outcomes of CRP, PA and BP at time two (2011). A total of 1452 subjects attended both screening events in 2009 and 2011 and comprise the sample for these analyses. The proportion of missing values across outcome variables in the multivariate analysis ranges from .05% for CRP to 3% for PA. None of the community health promotion events were shown to mediate any of the outcome variables of interest. However, the physical activity (PHYS) variable was kept in the SEM models since physical activity has previously been significantly associated with levels of CRP, BP and PA (Kokkinos & Myers, 2010).

CRP

Females and CRP. The female-specific SEM model for CRP demonstrated that none of the community health promotion interventions directly mediated the relationship between stress in 2009 and CRP in 2011. The CRP model did not demonstrate that there was an indirect effect of stress in 2009 on CRP in 2011 through PHYS and stress in 2011.

However, stress in 2011 was associated with an increase in CRP in 2011. For every one unit increase in stress in 2011, women saw a .09 increase in CRP in 2011, (β = .09, se(β) = .04, p = 0.02). The covariate of BMI in 2009 was significantly associated with CRP levels in 2009 for females (β = .29, se(β) = .02, p = <0.001). After trimming for non-significant variables, the fit statistics for the final model exploring CRP in women showed: CFI = 0.24, TLI = 0.13, RMSEA = 0.13 and SRMR = 0.12. These results are presented in Figure 3.2 and in Table 3.2.

Males and CRP. The male-specific SEM model for CRP also demonstrated that none of the interventions mediated the relationship between stress in 2009 and CRP in 2011. The male-specific model did not show that there was an indirect effect of stress in 2009 on CRP in 2011 through PHYS and stress in 2011. Covariates in 2009 that were significantly associated with CRP in 2009 include: history of diabetes (β = 1.2, se(β) = .43, p = 0.02), BMI, (β = .17, se(β) = .02, p = <0.001), age, (β = .02, se(β) = .008, p = 0.006), and cigarette use (β = .36, se(β) = .18, p = .04). After trimming for non-significant variables, the fit statistics in the final model exploring CRP in males was: CFI = 0.08, TLI = -0.06, RMSEA = 0.11and SRMR = 0.1. Model-specific details are provided in Table 3.2.

Figure 3.2.

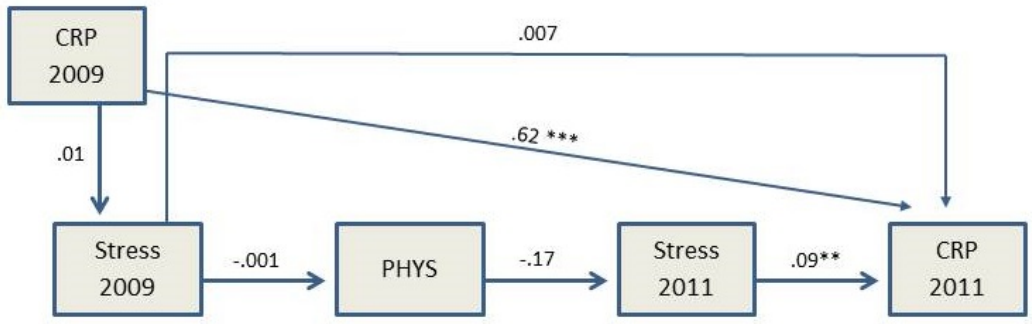

Figure 3.2. Exploratory path analysis of stress on CRP for females. Path coefficients are represented by: β. PHYS = physical activity interventions. *$p < .10$. **$p < .05$. ***$p < .001$.

Table 3.2

Path Analysis Results for CRP

		Male		Female	
Dependent	Independent	β(se(β)	p-value	β(se(β)	p-value
CRP09	Heart_HX_2009	.11(.43)	.80	.83(.54)	.13
	DM_HX_2009	1.2(.48)	.02	-.56(.48)	.24
	BMI_2009	.17(.02)	<.001	.29(.02)	<.001
	Age_2009	.02(.008)	.006	-.002(.007)	.79
	PSS_2009	.01(.05)	.78	.01(.04)	.75
	Cigarette_2009	.36(.18)	.04	.21(.17)	.21
PHYS Programs	PSS_2009	-.001(.002)	.71	-.001(.003)	.66
CRP11	CRP09	.12(.02)	<.001	.62(.02)	<.001
	PSS_2011	.02(.04)	.72	.09(04)	.02
		Indirect Effects			
CRP11	PSS_2009 through PHYS and PSS_2011	.011(.05)	.78	.007(.023)	.75
		Model Fit			
		Estimate		Estimate	
CFI		.08		.24	
TLI		-.06		.13	
RMSEA		.11		.13	
SRMR		.11		.12	

Note: Heart_HX_2009 = diagnosis of heart disease at baseline; DM_HX_2009 = diagnosis of diabetes mellitus at baseline; BMI_2009 = body mass index at baseline; Age = age at baseline; MEDHYP 2009 = use of hypertensive meds at baseline; Cigarette_2009 = history of smoking at baseline; PSS_2009 = perceived stress total at baseline; PSS_2011 = perceived stress total in 2011; PHYS Programs = physical activity interventions; CRP09 = C-reactive protein at baseline; CRP11 = C-reactive protein in 2011. *p < .10. **p < .05. ***p < .001.

Females and SBP. The female-specific SEM model for SBP demonstrated that none of the community health promotion interventions directly mediated the relationship between SBP in 2009 and CRP in 2011. The female-specific model demonstrated a borderline significant indirect effect of stress in 2009 on SBP in 2011 via PHYS and stress in 2011 (β = .12, se(β) = .07, p =<0.08). Additionally, a borderline significant effect (p=.08) was demonstrated for the effect of stress in 2011 on SBP in 2011 with a moderate beta of 0.24, such that for every one unit increase in stress in 2011, there was a .24 point increase in SBP in 2011. The 2009 demographics significantly associated with SBP levels in 2009 include: age (β = .35, se(β) = 17.14, p =<0.001); BMI, (β = .83, se(β) = 17.41, p = <0.001); and hypertensive medication use (β = 6.3, se(β) = 8.19, p = <0.001). The fit statistics for the final model exploring SBP in women are as follows: CFI = 0.28, TLI = 0.19, RMSEA = <.001 and SRMR = 0.14.

Males and SBP. The male-specific SEM model for SBP demonstrated that none of the community health promotion interventions mediated the relationship between stress in 2009 and SBP in 2011. The male-specific model did not show that there was an indirect effect of stress in 2009 on SBP in 2011 via PHYS and stress in 2011. A history of heart disease (β = -5.22, se(β) = -4.40, p =<.001); a history of diabetes (β = -2.67, se(β) = -2.05, p =.04); age (β = .14, se(β) = 5.9, p =<.001); body mass index (BMI), (β = .71 se(β) = 11.01, p = <.001); hypertensive medication use (β = 3.69, se(β) = 4.51, p = <.001); and cigarette smoking (β = .95 se(β) = 1.94, p = .052) in 2009 were significantly associated with SBP levels in 2009 for males. The fit statistics for the final model exploring SBP in men are as follows: CFI = 0.35, TLI = 0.29, RMSEA = <.001 and

SRMR = 0.09. Model specific details for males and females are provided in Table 3.3 and the path diagram for the SBP path analysis for females is presented in Figure 3.3.

Figure 3.3.

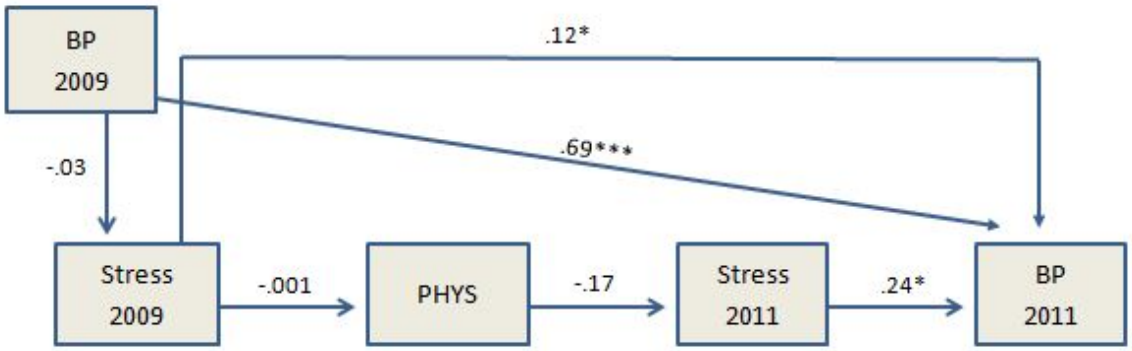

Figure 3.3. Stress on SBP for Females. Path coefficients are represented by: β.
*$p < .10$. **$p < .05$. ***$p < .001$.

Table 3.3

Path Analysis Results for SBP

		Male		Female	
Dependent	Independent	β(se(β)	p-value	β(se(β)	p-value
SBP09	Heart_HX_2009	-5.22(-4.40)	<.001	.24(.162)	.87
	DM_HX_2009	-2.67(-2.05)	.04	-1.5(-1.2)	.23
	Age_2009	.14(5.9)	<.001	.35(17.14)	<.001
	BMI_2009	.71(11.01)	<.001	.83(17.41)	<.001
	MEDHYP 2009	3.69(4.51)	<.001	6.3(8.19)	<.001
	Cigarette_2009	.95(1.94)	.052	-.16(-.36)	.72
	PSS_2009	-0.08(-0.66)	.51	-.03(-.31)	.75
PHYS Programs	PSS_2009	-.001(-0.37)	.71	-.001(-.44)	.66
PSS_2011	PHYS Programs	-.52(-2.02)	.043	-.17(-.97)	.33
SBP11	SBP09	.51(15.4)	<.001	.69(31.77)	<.001
	PSS_2011	-.04(.18)	.80	.24(1.76)	.08
		Indirect Effects			
SBP11	PSS_2009 through PHYS and PSS_2011	-.07(.12)	.57	.12(.07)	.08
		Model Fit			
		Estimate		Estimate	
CFI		.35		.28	
TLI		.29		.19	
RMSEA		<.001		<.001	
SRMR		.09		.14	

Note: Heart_HX_2009 = diagnosis of heart disease at baseline; DM_HX_2009 = diagnosis of diabetes mellitus at baseline; BMI_2009 = body mass index at baseline; Age = age at baseline; MEDHYP 2009 = use of hypertensive meds at baseline; Cigarette_2009 = history of smoking at baseline; PSS_2009 = perceived stress total at baseline; PSS_2011= perceived stress total in 2011; PHYS Programs = physical activity interventions; CRP09 = C-reactive protein at baseline; CRP11 = C-reactive protein in 2011. *p < .10. **p < .05. ***p < .001.

Physical Activity

SEM analysis for PA was divided into two separate models, one for females and one for males. Within each of these sex-specific models, we explored the paths for < moderate PA and > moderate PA with moderate PA as the reference group.

Females and < moderate PA. The female-specific SEM model for < mod PA demonstrated that none of the community health promotion interventions directly mediated the relationship between stress in 2009 and PA in 2011. The female-specific model demonstrated a significant indirect effect of stress in 2009 via PHYS and stress in 2011 on < mod PA, (OR (95%CI) = 1.01(1.004, 1.02), p = <.001); each increase of one in stress 2009, through its effect on attending a PHYS program and stress in 2011 resulted in a 1% increase in the chance of being in the < moderate PA group. In 2009, the demographic variables that were significantly associated with < mod PA in 2009 included a history of heart disease (OR (95%CI) = .90(.81, .99), p = .01), such that if women had heart disease, they were 10% less likely to be in the < mod PA group. For every one unit increase in BMI, women were 1% less likely to be in the < mod PA group (OR (95%CI) = .99(.986, .994), p = <0.001). A borderline significant effect of cigarette smoking was found, (OR (95%CI) = NA, p-value = .09). Mplus estimates were not carried to enough decimal points to estimate OR's.

Females and > moderate PA. The female-specific SEM model for >mod PA demonstrated that none of the community health promotion interventions mediated the relationship between stress in 2009 and > mod PA in 2011. The female-specific model for > mod PA in 2011 demonstrated a significant indirect effect of stress in 2009 on > PA

in 2011 through PHYS and stress in 2011; each increase of one in stress 2009, through its impact on attending a PHYS program and increase in stress in 2011 demonstrated a 0. 3% increase in the chance of being in the > moderate PA group (OR (95%CI) = 1.003(1.0006, 1.007) p = .04). The 2009 demographics significantly associated with > mod PA in 2009 include: BMI (OR (95%CI) .995(.993, .997), p = <0.001), such that for each increase in BMI, women were 1% less likely to be in the > mod PA group. For every 1 year increase in age, women were .5% less likely to be in the > mod PA group (OR (95%CI) = .995(.993, .997), p = .02). The fit statistics for the final model exploring PA in women are as follows: CFI = 0.89, TLI = 0.81, RMSEA = 0.07 and SRMR = 0.05.

Males and < moderate PA. The male-specific SEM model for < mod PA demonstrated that none of the community health promotion interventions mediated the relationship between stress in 2009 and PA in 2011. The male-specific model for < mod PA in 2011 demonstrated a significant indirect effect of stress in 2009 on PA in 2011 via PHYS and stress in 2011- each increase of one in stress 2009, through its impact on attending a PHYS program, and increase in stress in 2011 resulted in a .6% increase in the chance of being in the < moderate PA group (OR (95% CI) = 1.006(1.002, 1.01), p = <.001). 2009 demographics significantly associated with < mod PA in 2009 include: a history of heart disease, such that men with heart disease were 8% less likely to be in the < mod PA group (OR (95% CI) .92(.85, .99), p = .04); Each 1 unit increase in BMI indicated that men were 1% more likely to be in the < mod PA group (OR (95%CI) 1.01(1.006, 1.014), p = <.001). For each 1-year increase in age, men were .4% less likely to be in the < mod PA group.

Males and > moderate PA. The male-specific SEM model for > mod PA demonstrated that none of the community health promotion interventions mediated the relationship between stress in 2009 and > mod PA in 2011. The male-specific model for > mod PA in 2011 also demonstrated a significant indirect effect of stress in 2009 on PA in 2011 through PHYS and stress in 2011 (OR (95%CI) = .993(.987, .999) p = .003). Each increase of one in stress 2009, through its impact on attending PHYS and increase in stress in 2011 would result in an 1% decrease in the chance of being in the > moderate PA group. 2009 demographics significantly associated with > mod PA in 2009 include: BMI (OR (95% CI) .99(.986, .994) p = <.001) and every one unit increase in BMI indicated that men were 1% less likely to be in the > mod PA group; and age OR (95%CI) 1.004(1.002, 1.006) p = <.001) indicating that with each 1 year increase in age, men were .4% more likely to be in the > mod PA group. The fit statistics for the final model exploring PA in men are as follows: CFI = 0.64, TLI = 0.37 RMSEA = 0.13 and SRMR = 0.07. Model-specific details for PA in males and females are provided in Table 3.4, and the path diagrams for the PA path analysis for females and males are presented in Figures 3.4 and 3.5.

Table 3.4

Path Analysis Results for PA

		Male		Female	
Dependent	Independent	OR(95%CI)	p-value	OR(95%CI)	p-value
PA09<mod	Heart_HX_2009	.92(.85, .99)	.04	.90(.81, .99)	.04
	DM_HX_2009	.996(.92, 1.1)	.92	.98(.91, 1.1)	.66
	BMI_2009	1.01(1.006, 1.014)	<.001	.99(.986, .994)	<.001
	Cigarette_2009	NA[1]	.75	NA[1]	.09
	Age	1.004(1.002, 1.006)	<.001	.999(.997, 1.001)	.10
	PSS_2009	1.02(1.01, 1.03)	<.001	.98(.97, .99)	<.001
PA09>mod	Heart_HX_2009	1.08(1.002, 1.2)	.05	.998(.92, 1.08)	.96
	DM_HX_2009	.96(.87, 1.06)	.46	1.04(.96, 1.13)	.27
	BMI_2009	.99(.986, .994)	<.001	.995(.993, .997)	.001
	Cigarette_2009	NA[1]	.54	NA[1]	.87
	Age	.995(.993, .997)	<.001	.999(.998, .9998)	.02
	PSS_2009	.98(.97, .99)	<.001	.999(.993, 1.005)	.73
PHYS Programs	PSS_2009	.999(.995, 1.003)	.71	.999(.993, 1.005)	.59
PSS_2011	PSS_2009	1.8(1.7, 1.9)	<.001	1.68(1.6, 1.7)	<.001
	PHYS Programs	.63(.38, 1.05)	.08	.81(.62, 1.07)	.14
PA11<mod	PA09<mod	1.08(1.04, 1.1)	<.001	.55(.53, .57)	<.001
	PA09>mod	.95(.91, .99)	.003	.98(.94, 1.02)	.35
	PSS_2011	1.01(.999, 1.01)	.052	1.002(.99, 1.01)	.59
PA11>mod	PA09<mod	.96(.91, 1.02)	.14	.96(.94, .98)	<.001
	PA09>mod	1.14(1.1, 1.2)	<.001	.64(.63, .65)	<.001
	PSS_2011	.99(.986, 1.002)	.14	1.004(1.00, 1.008)	.04
		Indirect Effects			
PA11<mod	PSS_2009through PHYS Programs and PSS_2011	1.006(1.002, 1.01)	<.001	1.01(1.004, 1.02)	<.001
PA11>mod	PSS-T_09through PHYS and PSS_T_11	.993(.987, .999)	.003	1.003(1.0006, 1.007)	.04

Model Fit		
	Estimate	Estimate
CFI	.64	.89
TLI	.37	.81
RMSEA	.13	.07

Note: Heart_HX_2009= diagnosis of heart disease at baseline; DM_HX_2009= diagnosis of diabetes mellitus at baseline; BMI_2009 = body mass index at baseline; Age = age at baseline; MEDHYP 2009 = use of hypertensive meds at baseline; Cigarette_2009= history of smoking at baseline; PSS_2009= perceived stress total at baseline; PSS_2011= perceived stress total in 2011; PHYS Programs = physical activity interventions; CRP09 = C-reactive protein at baseline; CRP11 = C-reactive protein in 2011. *p < .10. **p < .05. ***p < .001. [1]NA: Mplus estimates not carried to enough decimal points to estimate ORs. *p < .10. **p < .05. ***p < .001.

Figure 3.4.

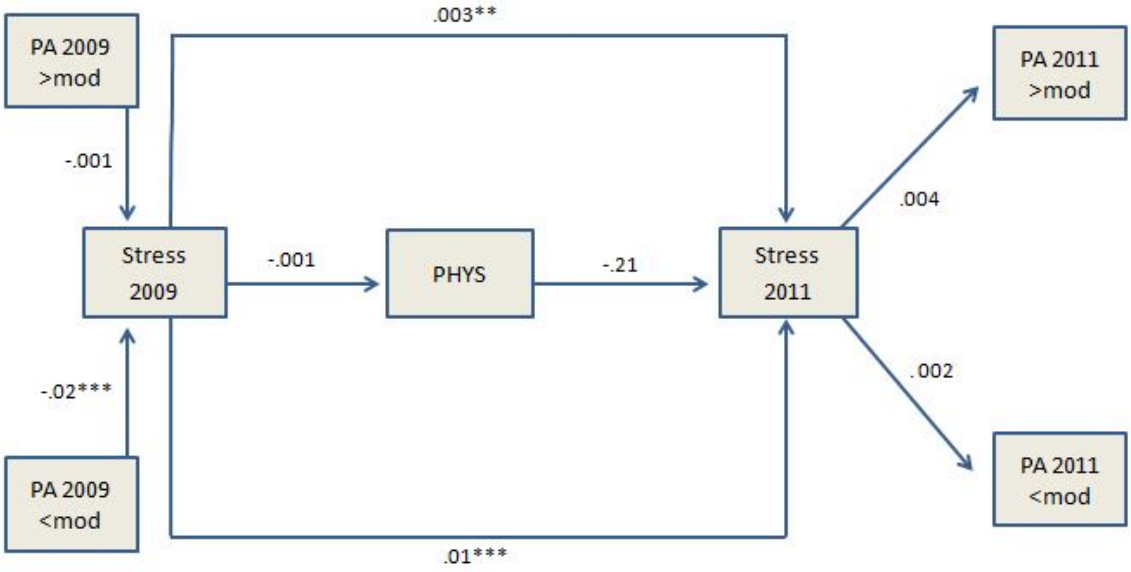

Figure 3.4. Stress on PA for Females. Path coefficients are represented by: OR.
*p < .10. **p < .05. ***p < .001.

Figure 3.5.

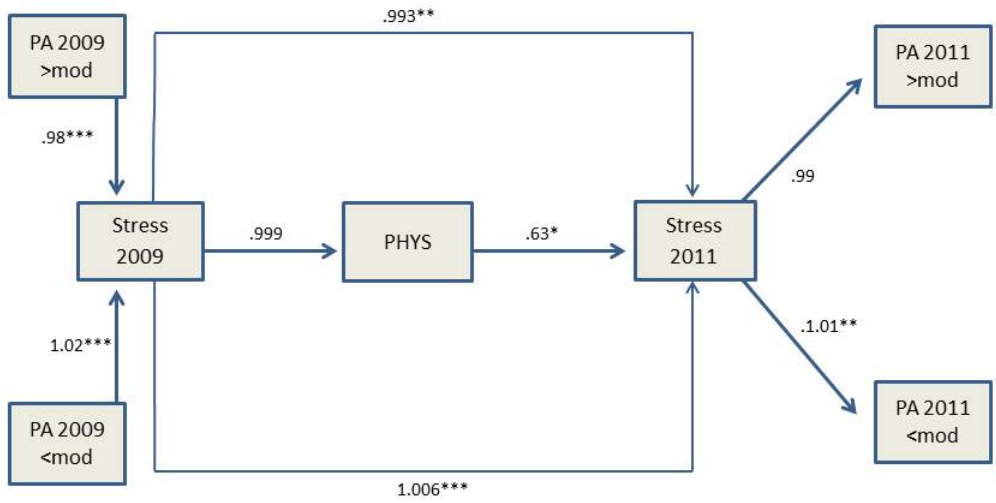

Figure 3.5. Stress on PA for Males. Path coefficients are represented by: OR.
*$p < .10$. **$p < .05$. ***$p < .001$.

Discussion

For this analysis, we hypothesized that HONU programming would mediate the effects between stress at baseline (2009) on the outcomes of CRP, PA or SBP at follow-up (2011). While our hypothesis was not supported by this exploratory path analysis, important findings were generated.

CRP

Among women, a one unit increase in stress was associated with an increase in CRP of .09 points. CRP has been demonstrated to be useful in the clinical setting to

predict cardiac event outcomes and CVD (Myers et al., 2004). The Centers for Disease Control and Prevention (CDC) directed physicians to use CRP as part of a measure of global risk of CVD assessments at their discretion in 2003 (Pearson et al., 2003). Utilizing CRP assessments for patients at intermediate risk for developing CVD was recommended by the Canadian Cardiovascular Society in 2009 (Genest et al., 2009). Additionally, the 2010 AHA Task Force guidelines suggest that utilizing CRP levels is "reasonable" for intermediate risk patients (Greenland et al., 2010). In a prospective, nested case–control study among women, CRP was shown to be more predictive of CVD when compared to 12 other common markers for CVD: serum amyloid A, soluble intercellular adhesion molecule type 1, interleukin-6, total cholesterol, LDL cholesterol, HDL cholesterol, apolipoprotein A-I, apolipoprotein B-100, Lp (a) lipoprotein, ratio of total cholesterol to HDL cholesterol, and homocysteine (Ridker, Hennekens, Buring, & Rifai, 2000).

Over the past decade, there has been an ongoing debate regarding inclusion of CRP as a valid predictor of cardiovascular events (Kaptoge et al., 2012). CRP levels can be elevated due to trauma, or infection or in those who have been recently hospitalized (Ridker, 2003). CRP acute phase protein can be produced in response to injury or acute infection and is a common marker to indicate systemic inflammation (Danesh et al., 2004). The benefits of using CRP as a marker for risk have gained traction in the last decade, however, it is still considered to be an imperfect marker of inflammation and the limitations of using CRP must be kept in mind. While the results of this path analysis indicated that the effect size of stress on CRP is small, it provides important information

related to the relationship between stress and CRP in women. These results indicate that increases in stress correspond to increases in CRP among women in this rural population.

SBP

Among females, a borderline significant indirect effect of stress in 2009 on SBP in 2011 through PHYS and stress in 2011 was shown, with every one unit increase in stress in 2009 corresponding to a .12 point increase in SBP in 2011. Additionally, stress in 2011 demonstrated a borderline significant (p = .08) association with SBP in 2011- indicating that for every one unit increase in stress in 2011, there was a .24 point increase in SBP. While this demonstrates a borderline statistically significant change, this may not translate into a clinically significant change. A previous analysis of the HONU data (Sillah et al., 2014) explored association between program participation and blood pressure control and found that the clinical, worksite, nutrition and physical activity programs were associated with improvements in BP among those with uncontrolled BP at baseline.

Physical activity. As with the other outcomes of interest, HONU programming did not mediate the effect of stress at baseline on the outcome of PA at follow-up. However, both of the female specific models exploring < mod PA and > mod PA models both demonstrated significant indirect effects of stress in 2009 via PA and stress in 2011 on < mod PA and > mod PA, respectively. Females who increased their stress levels were more likely to be in the < mod PA group. Previous research has shown an association between physical activity and stress in women. In a group of 1200, 18-45 year old women, Kull (2002) found that women who were physically active experienced less

depression, had improved mental health and had an overall better general health status compared to those who were not physically active. In a large observational study of 12,028 individuals, men and women who were physically active were less likely to report dissatisfaction with life and were less likely to be affected by stress (Schnohr, Kristensen, Prescott, & Scharling, 2005).

The male-specific PA models demonstrated significant results as well. Those with an increase of one in stress were .6% more likely to be in the < mod PA group, interestingly an inverse relationship between stress and PA was also shown. Men who reported a one point increase in stress were 1% less likely to be in the > mod PA group. While these results were small, they were still significant, mirroring earlier work on the relationship between stress and PA. Previous work exploring stress and physical activity have shown similar relationships, however, most studies have been specific to the effects of workplace stress on physical activity levels (Kouvonen et al., 2013; Nelson et al., 2014).

The fit indices that were found for the six path analysis conducted did not meet the requirements for standard goodness of fit tests, with the exception of the physical activity models. This may indicate that other variables not measured would provide an important explanation of variance in the models. However, fit statistics are not of primary interest when exploring new models (Schreiber, Stage, Barlow, and King, 2006).

Limitations

There are several limitations for the analysis presented. First, the results of this study may have limited generalizability to other populations in part due to the volunteer

bias of those who attended both screening events in 2009 and 2011. A previous analysis of the sub-group that returned in 2011 showed that they were generally healthier at baseline compared to those who only attended the 2009 screening event (Kim et al., 2013; Sillah et al., 2014). Additionally, those who returned for the 2011 screening events may have been more motivated and more likely to participate in the HONU programming. A second limitation is the potential recall bias and the self-reported counts of program participation over the course of two years between the screening events. Program counts were also not captured in the 2011 screening; the participants were only allowed to check one box if they had participated in multiple times in the specified program over the course of the two years. It was not feasible to weight the HONU programs prior to the path analysis; clearly some of the programs as described in Table 1 were far more intensive.

Finally, there are inherent limitations with secondary data analysis. Special consideration must be given to examine the procedures conducted in the parent study to ensure that the data collection, sampling methods and the use of the original sample population do not affect the validity of the secondary data analysis (Jacobson, Hamilton, & Galloway, 1993). Secondary data anlysis can highlight the potential discrepancy between the proposed conceptual framework of the secondary analysis to that of the original conceptual framework for the parent study.

Conclusion

While the results of this analysis did not show a mediation effect of HONU programming on CRP, BP or PA, important findings were found that indicate that stress

levels are significantly associated with physical activity levels, systolic blood pressure and CRP in this rural population. Future studies are warranted to explore the relationships with stress and physical activity, BP and CRP in other populations. Additionally, more research is warranted to explore the effects of utilizing more robust programming to mediate the effects of stress on other modifiable CVD risk factors.

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Chapter 4: Manuscript Three

This chapter describes the results of Aim 4 of this dissertation. In this chapter we describe the results of a literature review that explored the use of motivational interviewing to reduce CVD risk among two populations that experience health disparities: African American and Latina women.

Title: Motivational Interviewing to Reduce Cardiovascular Risk in African American and Latina Women (© Western Journal of Nursing Research)

Dawn R. Witt, MPH[1,2]

Ruth Lindquist, PhD, RN[1]

Diane Treat-Jacobson, PhD, RN[1]

Jackie L. Boucher, MS, RD[2]

Suma H. Konety, MD, MS[3]

Kay Savik, MS[1]

[1]University of Minnesota School of Nursing

[2]Minneapolis Heart Institute Foundation

[3]University of Minnesota School of Medicine
Minneapolis, Minnesota

Author Note
Dawn R. Witt, University of Minnesota School of Nursing
Correspondence concerning this article should be addressed to Dawn Witt
5-140 Weaver Densford Hall 308 Harvard Street, SE Minneapolis, MN, 55455
Contact: witt0175@umn.edu

Cardiovascular disease (CVD) is the leading cause of death for women, and disproportionally so for African American and Latina women. CVD is largely preventable and attributed to health behaviors; however, implementing and sustaining positive health behaviors is a challenge. Motivational interviewing is one promising intervention for initiating behavior change. The purpose of this review was to identify, synthesize and critically analyze the existing literature on the use of motivational interviewing as a behavioral intervention to reduce CVD risk among African American and Latina women. Seven studies were identified that met inclusion criteria. Results of this review suggest that motivational interviewing has mixed results when used to reduce cardiovascular risk factors in African American and Latina women. More research using a standardized motivational interviewing approach is needed to definitively determine if it is an effective behavioral intervention to reduce CVD risk when used in populations of African American and Latina women.

Key words: cardiovascular disease, women, African American, Hispanic, Latina, motivational interviewing

Between 1980 and 2007, there was a reduction in the age-adjusted death rate of women who died due to cardiovascular disease (CVD), which has been attributed to primary and secondary prevention measures (Ford et al., 2007). Primary prevention identifies and targets people at increased risk, but with no evidence of CVD, while secondary prevention seeks to reduce risk in individuals with established disease. Over the past decade, there have also been improvements in the rates of awareness among women that CVD is the leading cause of death. In 1997 only 30% of women were aware that CVD was the leading cause of death among women; the rate of awareness has grown to 54% in 2009. However, awareness is not consistent across all segments of the population. African American and Latina women are less likely to recognize that CVD is the leading cause of death for women compared to white women, and each year, 34.2% of African American women and 29.6% of Latina women die from CVD (Go et al., 2013; Mosca, Mochari-Greenberger, Dolor, Newby, & Robb, 2010; Mosca et al., 2011).

The greatest proportion of CVD burden for African American and Latina women are specifically related to diabetes, overweight and obesity, and lower levels of physical activity when compared to white women (Roger et al., 2011). Fortunately, these risk factors for CVD are largely preventable. Behavioral interventions that target these modifiable risk factors are one way to address these risks, and motivational interviewing is one technique that has shown promise to address the modifiable risk factors for CVD.

There is a significant gap in the literature addressing the effectiveness of behavioral interventions for CVD prevention in women, particularly among African American and Latina women. Traditionally, behavior change methods have relied on

the approach of “advice giving” with limited success in uptake and maintenance of behavior change (Brodie & Inoue, 2004; Cifuentes et al., 2005; Hillsdon, Thorogood, White, & Foster, 2002). Motivational interviewing has been demonstrated as an effective counseling approach for treatment of a broad range of lifestyle problems and diseases; and it outperformed traditional advice-giving in a systematic review and meta-analysis of 72 randomized controlled trials (Rubak, Sandbaek, Lauritzen, & Christensen, 2005). However, although the review of the efficacy of motivational interviewing was comprehensive, it did not specifically address its use to improve cardiovascular risk behaviors and outcomes in populations of African American and Latina women.

The purpose of this review was to identify, synthesize and critically analyze the existing literature on the use of motivational interviewing as a behavioral intervention to reduce CVD risks or improving cardiovascular risk-related behaviors among African American and Latina women.

The American Heart Association recommends that all women over the age of 20 undergo a CVD health screening including history of tobacco use, lipid disorders, obesity, hypertension, diabetes and other nontraditional risk factors (Roger et al., 2011). Health screening initiatives such as the CDC- funded WISEWOMAN (Well-Integrated Screening and Evaluation for Women Across the Nation) program target minority populations of middle-aged women at risk for developing stroke, heart disease or other chronic illness (Will, Farris, Sanders, Stockmyer, & Finkelstein, 2004). In 2002, WISEWOMAN screened over 8000 disadvantaged, multicultural women at 10 sites

across the U.S. and implemented interventions targeting physical activity and nutrition (Will et al., 2004). Developing behavioral interventions to address the modifiable CVD risk factors including nutrition, diabetes, smoking, hypertension, hyperlipidemia, metabolic syndrome and physical activity are an effective way to reduce CVD prevalence (Grundy, 2007; Roger et al., 2011; Rubak et al., 2005).

Previous studies that have used motivational interviewing to reduce CVD risk factors demonstrated overall favorable outcomes, particularly when the intervention was delivered in- person and over an extended period of time. In a systematic review and meta-analysis of motivational interviewing across a broad array of lifestyle behaviors known to improve health and reduce disease risks conducted by Rubak et al. (2005), 80% of studies that were reviewed demonstrated positive motivational interviewing-facilitated behavior change compared to traditional advice-giving. Use of behavioral interventions such as motivational interviewing to address CVD risk factors have shown to have benefit in increasing physical activity (Carels et al., 2007; Hardcastle, Taylor, Bailey, & Castle, 2008; Perry & Bennett, 2006); improvement in diet (Carels et al.,2007; Hardcastle et al., 2008); decreases in diastolic blood pressure (Hardcastle et al., 2008); decreases in body mass index (Hardcastle et al., 2008); and increases in social support (Perry & Bennett, 2006). Moreover, motivational interviewing has not been reported to cause any adverse outcomes or ill effects (Rubak et al., 2005).

Motivational interviewing is a counseling technique that has been used to promote healthy behaviors to prevent or manage disease by eliciting behavior

change (Rubak et al., 2005). Motivational interviewing can be described as a non-confrontational and patient-directed approach, where the counselor engages in empathetic listening and helps guide the patient to recognize their ambivalence about behavior change (Miller & Rollnick, 2002). Motivational interviewing meets people "where they are", and has been shown to be effective for those who are not ready or less motivated to change (Hettema, Steele, & Miller, 2005).

Motivational interviewing has roots in the patient- centered counseling approach developed by Rogers (1951). Motivational interviewing was not initially informed by a clear theoretical framework; however, it has been proposed that the self-determination theory is one such method that can be useful in framing motivational interviewing (Markland, Ryan, Tobin & Rollnick, 2005). The self-determination theory emphasizes that the change must originate from within the person, rather than the provider or counselor pressuring the client to change their behavior. Additionally, motivational interviewing and the self-determination theory are inclined to value the ability of personal growth (Deci & Ryan, 1985). It was originally developed and used in the addiction field (Miller, 1983) and has since been more widely implemented in efforts to address the prevention of chronic illness and promotion of health behaviors (Resnicow et al., 2002).

The focus and goals of motivational interviewing are to encourage clients to consider their reasons for and against changing a behavior; how the behavior in question may interfere with their goals for health; and how this interference of goals will have an effect on lifestyle overall. Instead of persuading the client to make changes, techniques

such as reflective listening, agenda or goal-setting, rolling with resistance, and eliciting change-talk are employed by motivational interviewing counselors (Miller & Rollnick, 2002). There are four key components comprising motivational interviewing: (1) expressing empathy, (2) agenda or goal setting, (3) rolling with resistance, and (4) eliciting change talk and supporting self-efficacy (Figure 1).

Expressing empathy allows the healthcare professional to hear and understand the patients experiences through the use of reflective listening, engendering an environment where the patient is comfortable sharing his or her experiences. Reflective listening provides an opportunity to help clients develop an awareness of thoughts, feeling or behaviors that may be interfering with achieving goals. Restating what a client says, in a slightly different manner, can highlight this discrepancy in thoughts and feelings compared to the actual behaviors that are currently occurring.

Agenda or goal setting allows the patient to see the discrepancy between existing behaviors in contrast to where a patient see's oneself. Asking questions such as "What concerns do you have about your diet?' or "Do you have any concerns about your exercise regimen?" allows a patient to clarify and affirm goals in a non-judgmental, supportive environment engendering recognition of existing behaviors in contrast to what the client would like to achieve.

Rolling with resistance is another key component of motivational interviewing (Miller & Rollnick, 2002). As a client struggles with the disconnect and difficulty in moving toward behavior change, the health professional provides support-- neither advocating for or against a behavior, rather, reflecting the comments and situation

back to the client. Motivational interviewing involves supporting the client and encouraging feelings of self-efficacy.

Eliciting change talk and supporting self-efficacy for positive behavior change is the fourth component of motivational interviewing (Miller & Rollnick, 2002). Health care providers can increase a patients' self-efficacy by expressing their support and belief that the patient is capable to change their behavior and by highlight the patients' past successes.

Figure 4.1.

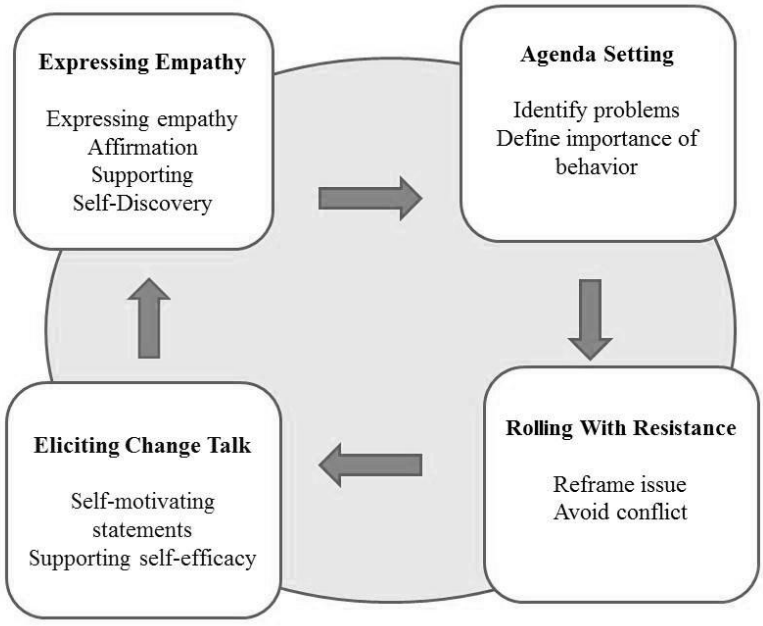

Figure 4.1. Core Components of Motivational Interviewing

Motivational interviewing is a framework that has shown promise in numerous populations to facilitate behavior change (Miller & Rollnick 2002); however its application to reduce CVD risk in African American and Latina women

is unknown. Therefore, this review was conducted to identify, synthesize and critically analyze the existing literature on the use of motivational interviewing as a behavioral intervention to reduce CVD risk factors among African American and Latina women. In the review, the following research question was addressed:

Does the use of motivational interviewing reduce CVD risk factors in African American and Latina women?

Methods

Three electronic databases were used for the search (CINAHL, MEDLINE, and PsychINFO), utilizing the keywords *cardiovascular disease, women, African American, Hispanic, Latina* and *motivational interviewing*. Inclusion criteria for this literature review included: English, humans, adults, a motivation-based counseling protocol used as the treatment, inclusion of African American women, and inclusion of Latina or Hispanic women. Another inclusion criteria was that the work directly assessed the effects of motivational interviewing on at least one modifiable CVD risk factors including physical activity, diet as measured by fruit and vegetable consumption, BMI, systolic blood pressure, glycemic control, weight loss, and medication adherence. Date limits were set to include literature from 1980 to January 2013. Electronic searches were supplemented by cross-referencing and duplicates were deleted across the database searches. Given the small body of literature, study completion rates did not affect inclusion in this review. There were no limits placed on study design, since few randomized controlled studies for this population and topic were identified. Studies were excluded if < 25% of the sample was comprised of African American or Latina

women; if the sample included < 50% women; if the target of motivational interviewing was not CVD risk factors; or if motivational interviewing was not the primary behavioral intervention being employed.

Results

A total of 40 papers were examined, yielding 7 studies that met the inclusion criteria for this systematic review (Befort et al., 2008; Corsino et al., 2012;Ogedegbe et al., 2008; Resnicow et al., 2005; Rocha-Goldberg Mdel et al., 2010; Villablanca et al., 2009; West, DiLillo, Bursac, Gore, & Greene, 2007). The 7 papers were individually evaluated in alphabetical order. A structured abstracting form with seven areas of focus was developed to capture the results of the literature reviewed: Author(s) and year of publication, study design and sample, dependent variable, intervention, and results was used to capture the study results (see Table 1).

Five of the studies included 38% or more African American women (Befort et al., 2008; Ogedegbe et al., 2008; Resnicow et al., 2005; Villablanca et al., 2009; West et al., 2007), and two studies included 58% or more Latina women (Corsino et al., 2012; Rocha-Goldberg Mdel et al., 2010). Among the studies examined, the mean age ranged from 40 to 79 years old (Corsino et al., 2012; Ogedegbe et al., 2008; Resnicow et al., 2005; Rocha-Goldberg Mdel et al., 2010). Research designs included four randomized controlled trials, two pilot studies, and one longitudinal pre-post educational study. All of the studies were conducted in the U.S, and included a wide range in sample sizes, from 17 to 1052 participants. Overall, the number of subjects across all studies comprised 462 men and 2020 women; the latter were the focus of this paper's synthesis

and analysis. The research question for this review asked whether the use of motivational interviewing was effective in reducing CVD risk factors or improving cardiovascular risk-related behaviors in African American and Latina women. The primary outcomes of interest that were measured were physical activity, weight loss, body mass index BMI), systolic blood pressure (SBP), glycemic control, diet as measured by fruit and vegetable consumption, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and medication adherence.

Table 4.1

Use of Motivational Interviewing to Reduce CVD Risk Factors in African American and Latina Women

AUTHOR, (YEAR)	DESIGN AND SAMPLE	INTERVENTION	DEPENDENT VARIABLE	RESULTS
Befort et al. (2008)	Randomized controlled trial N=44 obese African American women M age = 44.3	16 week behavioral weight loss program Group 1: 16 week program plus four MI sessions Group 2: 16 week program plus four health education/attention control sessions Addition of MI did not improve adherence or treatment outcomes for AA women. Both groups reported decrease in self-efficacy and motivation. Intervention delivered by doctorate level psychologist or master's level counselor or dietitian.	Weight Loss Diet	No difference in adherence or attainment of weight loss between groups
Corsino et al. (2012)	Pilot study N=56 84% Latina women M age = 38	20 weekly group sessions (90-120 minutes) incorporating MI techniques. Cultural adaptation included using foods, and activities common in Latino culture, using a Spanish speaking interventionalist and held in a local Latino community center.	Weight loss BMI Blood Pressure Diet Physical Activity	Significant reductions in weight, BMI, and systolic blood pressure

AUTHOR, (YEAR)	DESIGN AND SAMPLE	INTERVENTION	DEPENDENT VARIABLE	RESULTS
Ogedegbe et al. (2008)	Randomized controlled trial N= 190 men and 88% women Hypertensive African American sample population M age = 54	12 month intervention Group 1: Usual care Group 2: Usual care plus MI regarding medication adherence at 3, 6, 9 and 12 months. 30-40 minute MI session Intervention delivered by trained research assistants	Medication Adherence (measured by electronic pill monitors) Systolic blood pressure	Those in MI arm had a higher adherence rate (p = .054) compared to usual care group. Modest non-significant trend in reduction of SBP in MI group (p= .065)
Resnicow et al. (2005)	Randomized controlled trial N = 906 men and women 76% African American women M age = 46.3	Group 1: standard nutrition and physical activity materials Group 2: physical activity materials and culturally targeted nutrition materials Group 3: Same as Group 2, plus 4 MI phone calls Intervention delivered through Black churches. Intervention delivered by phone by master's or doctoral level psychologists	Fruit and vegetable consumption Physical activity	Statistically significant (< .05) increase in F & V consumption for those in Group 3 No statistically significant different outcomes of PA in group receiving MI (group 3) vs. group 1 and 2

AUTHOR, (YEAR)	DESIGN AND SAMPLE	INTERVENTION	DEPENDENT VARIABLE	RESULTS
West et al. (2007)	Randomized controlled trial N=217 women 38% African American Women Overweight, diabetic sample M age = 54	18 month intervention Both groups received 42 session weight mgmt. program- met weekly for 6 months, bi-weekly for 6 months, then monthly for 6 months. Intervention arm received MI for 45 minutes at baseline, 3, 6, 9 and 12 months vs. attention control sessions at same intervals. Weight loss among African American women lasted only until 12 month mark, and disappeared by 18 months. Intervention delivered by nutritionist, diabetes educator, exercise physiologist, and behaviorist	Weight loss Glycemic control	Women in MI group lost more weight at 6 months (P=.01) and 18 months (P=.04) African American women lost significantly less weight than white women at 6, 12 and 18 months MI enhanced glycemic control.
Villablaca et al. (2009)	Longitudinal pre or post-educational study N=1052 women 73% African American women M age = 40-60 *high dropout rate, with only 423 women completing all	7 month intervention Eight bi-weekly counseling sessions over 4 month period. Each group session lasted 90-120 minutes “Maintenance Sessions” for additional 3 months Interventions delivered at faith based and community sites. CV screenings conducted at baseline and post-intervention. Intervention delivered by medically trained personnel & lay personnel.	Weight Physical Activity 28 secondary measures	No significant change in primary outcomes Decrease in HTN, increase in knowledge of CVD risk modification

AUTHOR, (YEAR)	DESIGN AND SAMPLE	INTERVENTION	DEPENDENT VARIABLE	RESULTS
	follow-up time points.			
Rocha-Goldberg et al. (2010)	Feasibility pilot study N = 17 Latino men and women 58% Latina women M age = 46	6 weekly group sessions lasting 90-120 minutes. Recruitment of study participants improved when native Spanish speaking research assistants contacted potential participants.	Systolic blood pressure Body mass index Diet Measurements taken at baseline and 6 weeks	Systolic blood pressure (d= 1.01, large effect size) Weight (d = 0.49) medium effect size BMI decrease (d= 0.52)) Physical Activity (d = 0.68) medium effect size

Notes: PA indicates physical activity, SC indicates Standard Care, N indicates total sample size, AA indicates African American, MI indicates Motivational Interviewing, DM indicates diabetes mellitus, HTN indicates hypertension, GP indicates general practitioner, RD indicates Registered Dietitian, RA indicates Research Assistant, CVD indicates Cardiovascular Disease. HFSpN =Heart failure specialist nurse, APN= Advanced Practice Nurse, M indicates mean, F & V indicates fruit and vegetable consumption, $V0_2$ max indicates maximal oxygen consumption, LDL indicates low density lipoprotein, HDL indicates high density lipoprotein, SBP indicates systolic blood pressure and DBP indicates diastolic blood pressure.

Evidence Regarding Effectiveness of Motivational Interviewing to Reduce CVD Risk

Two studies, conducted by Resnicow et al. (2005) and Villablanca et al. (2009), explored the primary outcome of physical activity following the use of motivational interviewing with African American women delivered through Black churches or faith-based community sites. In these studies, different methods of delivery of the intervention were used. Villablanca et al. delivered motivational interviewing in-person, while Resnicow et al. delivered motivational interviewing by phone. There were no significant improvements in measures of physical activity in either study. However, Resnicow et al. reported an increase in fruit and vegetable consumption among those receiving motivational interviewing. Villablanca et al. demonstrated a significant decrease in hypertension, and a significant increase in knowledge of CVD risk modification. Villablanca and colleagues also sought to affect weight loss; however, there was no benefit apparent from motivational interviewing when compared to the control group.

West et al. (2007) implemented an 18-month randomized controlled trial comparing motivational interviewing to an attention control group to explore the outcomes of weight loss and glycemic control with African American and white women. Motivational interviewing was found to have a significant effect on weight loss at 6 and 12 months for those enrolled in the motivational interviewing arm of the study. However, African American women lost significantly less weight than white women at 6, 12 and 18 months. White women continued to lose weight for the duration of the 18-month study, while significant weight loss for African American women was not evident beyond 12 months.

Interestingly, Befort and colleagues (2008) reported a post-intervention decrease in adherence to health behavior changes among study participants in a 16-week behavioral weight loss program. The study participants also reported a decrease in self-efficacy, defined as ones' confidence in their ability to change a specific behavior under difficult circumstances (Bandura, 1997). The study sample comprised African American women and compared the use of motivational interviewing to health education. Despite the decrease in self-efficacy and motivation, there were significant improvements in fruit and vegetable consumption and weight loss for both groups. However, there were no significant differences when comparing the results of the intervention arm employing motivational interviewing to the arm utilizing health education (Befort et al., 2008). Corsino and colleagues (2012) found a similar significant reduction in weight loss in culturally adapted behavioral weight loss intervention for Latino's using motivational interviewing. The intervention was delivered by Spanish speakers in a local Latino community setting, and the intervention focused on use of foods and physical activities that are familiar to Latinos.

Three studies exploring reduction in SBP had mixed outcomes. Rocha-Goldberg Mdel et al. (2010) conducted a feasibility pilot study that was tailored to Latino males and females enrolled in 6 weekly group sessions incorporating motivational interviewing. In this study, participants had a significant decrease in SBP at the end of the intervention. Another small study conducted with Latino participants found that after 20 weekly group sessions of motivational interviewing, participants demonstrated a significant decrease in SBP (Corsino et al., 2012). This is in contrast to results of a study

conducted by Ogedegbe et al. (2008). In the latter study, African Americans received motivational interviewing sessions of 30-40 minutes at 3, 6, 9 and 12 months for blood pressure control. Investigators found a non-significant decrease of SBP. However, participants in the motivational interviewing intervention arm demonstrated a statistically significant difference in maintenance of medication adherence compared to the usual care group, whose medication adherence significantly decreased.

Discussion

The studies presented here address a wide variety of motivational interviewing interventions to promote behavior change to reduce CVD risk factors or to improve cardiovascular risk-related behaviors, including improving physical activity, managing weight, improved nutrition, increasing medication adherence, and management of hypertension among African American and Latina women. The studies had resulted in mixed results in improvements to reduce risk for CVD.

The studies comprising this review demonstrate that motivational interviewing can be delivered in a variety of settings, in varying time frames, and via different methods (i.e., in- person individual sessions, in-person group structure or telephonic motivational interviewing sessions). In the studies reviewed, varying doses of motivational interviewing were used. Across studies, there was no standard amount of time per-session, or number of sessions utilized. It is unclear whether the lack of standardization impacted the variability of findings related to the effectiveness of motivational interviewing interventions that was observed across studies.

The lack of standardization may reflect the fact that "best practices" related to the use of motivational interviewing have not been identified. Further questions need to be explored, such as: Are in-person motivational interviewing sessions more effective than distance sessions in reducing CVD risk factors? Are group sessions that use motivational interviewing as effective as individual motivational interviewing sessions? Is there a dose-response effect of motivational interviewing, with more sessions producing better outcomes? Might there be cultural preferences related to the acceptability or effectiveness of motivational interviewing? Data need to be sought to address consideration of the method of delivery (e.g., group vs. individual), training of those delivering motivational interviewing, length of individual sessions and duration of intervention. All are important aspects to consider when utilizing behavioral interventions such as motivational interviewing, and reports of studies examining the effects of motivational interviewing on outcomes should be explicit in detailing methods of intervention operationalization and delivery.

Addressing the modifiable risk factors for CVD is a crucial step to reduce the prevalence of CVD among populations of African American and Latina women (Roger et al., 2011). This review demonstrated that evidence for the use of motivational interviewing with African American and Latina women to reduce CVD risk women is sparse, and those studies that employed motivational interviewing have generated mixed results regarding its efficacy. However, the needs for effective behavioral interventions are great in these subgroups of women who remain at higher risk for CVD and CVD-related deaths. Although motivational interviewing results were inconsistent, the positive

effects that were attained in increasing fruit and vegetable consumption, decreasing hypertension/lowering SBP, achieving weight loss goals, and improving knowledge of CVD risk modification among those receiving motivational interviewing show some promise for the use of motivational interviewing among African American and Latina women. Findings also highlight the need for effective cultural adaptations of motivational interviewing and to consider how motivational interviewing protocols could be developed to impact behavior over longer periods of time.

In summary, there is an urgent need to further develop, test, and refine behavioral interventions such motivational interviewing to determine their efficacy to reduce CVD risk factors and to improve CVD-related health behaviors among African American and Latina women. Motivational interviewing has shown some promise in reducing CVD risk factors populations of African American and Latina women. However, more standardization in research methods is essential to generate definitive evidence, and for optimal operationalization of the intervention in specific populations.

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Chapter 5: Discussion

This chapter presents the major findings from each manuscript in this dissertation. First, a synthesis of the findings from the results of Chapters 2 and 3 from this dissertation will be presented along with the study limitations. Second, an overview of the findings from Chapter 4 is provided. Finally implications for future research are discussed.

Chapter 2 Findings

Baseline characteristics of the HONU population. In Chapter 2, sex-specific baseline characteristics of the primary outcomes of interest are described: stress levels, BP, CRP and PA in the New Ulm population that attended screening a screening event in 2009 as well as those who attended both screening events in 2009 and 2011. The effect of other covariates such as BMI, smoking, age and educational attainment of the outcome variables of PA, BP and CRP and the predictor variable of stress were also assessed. In these analyses, men reported significantly more moderate physical activity, had a significantly greater history of heart disease, and significantly higher SBP and DBP compared to women. Women in this study sample never smoked, were less educated, and had higher reported levels of stress and significantly higher levels of CRP when compared to men.

As discussed in Chapter 2, the higher levels of stress in women are noteworthy as previous research has demonstrated that women with high levels of high stress related to caregiving face increased risk of incident CHD and mortality (Lee, Colditz, Berkman, & Kawachi, 2003). Likewise, women reporting high levels of marital stress were more

likely to have a second cardiac event compared to those who reported less marital stress Orth-Gomer (2009). Additionally, high levels of stress are commonly reported in women with ischemic heart disease (Claesson, Burell, Birgander, Lindahl, & Asplund, 2003; Hallman, Burell, Setterlind, Oden, & Lisspers, 2001). A meta-analysis conducted by Steptoe and Kivimäki showed that results from population-based studies showed that individuals experiencing chronic stress have a 1.5 -fold excess risk for CHD, and they also found that acute stress can trigger a cardiac event (Steptoe et al., 2013).

In spite of the growing body of evidence, stress is still not widely accepted as a risk factor for CVD. The AHA guidelines for primary prevention of CHD do not include screening for psychosocial factors or stress (Pearson et al., 2002). This is in contrast to the 2012 European Guidelines on CVD prevention in clinical practice. These recommendations go beyond screening for the traditional CV risk factors and recommend screening for depression, anxiety, social isolation and stress associated with family or work (Perk et al., 2013). Interventions to manage stress have clearly shown that they can impact the other modifiable risk factors for CVD, thus offsetting the excess risk of CVD via improving diet, smoking cessation, and increases in physical activity (Steptoe and Kivimäki, 2013).

The 4-item Cohen Perceived Stress Scale (PSS4) (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1998) was used to assess stress in the HONU study population. There are three versions of the Cohen Perceived Stress Scale - the PSS14, PSS10 and the PSS 4 which was used in the HONU screenings. The PSS 4 has a demonstrated alpha reliability coefficient of .60 and has been shown to be useful when

brief measures of stress are needed. The PSS measures an individuals' general perception of stress based on events that have occurred in the previous month and assesses if and to what extent, an individual perceives their lives to be uncontrollable, unpredictable or overloaded. Consideration should be given to the subjective nature of measuring stress, however, it is impossible to conduct human studies to study the direct effect of stress on disease and understand the mechanistic effects of stress on health. With that limitation, we are left with grappling the best way to understanding the effects of the wide array of stressors- from the mundane day –to-day stressors, to the more acute stressors of death of a spouse, natural disasters, or loss of a job. For the purposes of the HONU study, the PSS 4 was an appropriate, brief tool to assess stress in this population.

Effect of change in stress on change in outcomes. In Chapter 2, the sex-specific differences in the changes in stress on changes in PA, BP and CRP in the cohort screened twice, in 2009 and 2011 were also explored. The hypothesis for this analysis was that there would be sex-specific differences for changes in measures of stress levels on changes in levels of BP, PA and CRP. The findings from this study demonstrated that change in levels of stress were not associated with corresponding changes in PA, CRP or BP for men. Among women, there was no significant association between change in stress on change in PA or CRP; however, there was a small but significant effect of change in stress on SBP. While this finding was statistically significant, translating the effect size into clinical significance may be more difficult. These findings are not surprising given that the overall change in stress between 2009 and 2011 was shown to be

very minimal, thus limiting the possibility that change in stress scores would be associated with changes in the outcome variables of CRP, PA and BP.

Chapter 3 Findings

In Chapter 3, the potential sex-specific differences in the mediating effects of the HONU programming between stress and the outcome variables of BP, PA and CRP were explored. The results of these analyses indicate that the five HONU program categories did not mediate the effect of stress levels in 2009 on the outcomes of BP, CRP and PA in 2011. However, significant indirect effects of stress were shown on several of the outcomes of interest.

Stress and SBP. The female-specific models demonstrated a borderline significant indirect effect of stress in 2009 on SBP in 2011. A separate study exploring the association between HONU program participation and blood pressure control, Sillah and colleagues (2013) found that those with uncontrolled BP at baseline who participated in any two HONU programs were 2.5 times more likely to have BP control at follow-up compared to those who participated in no programs.

The relationship between stress and hypertension is unclear and research has provided conflicting evidence as to the relationship between stress and hypertension. It is unclear whether acute, short-term increases in blood pressure due to repeated stressful events will have a negative cumulative effect on the vasculature of the heart (Schneiderman, Ironson & Siegal, 2005). Two reviews have determined that stress is an independent risk factor of hypertension, CV mortality and CAD (Kaplan & Nunes, 2003; Rozanski et al., 2005). Results from a meta-analysis conducted by Sparenberger and

colleagues (2009) showed that sustained blood pressure elevation was associated with chronic stress. It should be noted that however, that there are a wide range of methods to assess stress; stress can be measured objectively or subjectively, thus making comparisons between studies assessing stress difficult (Wiernik et al., 2012). Regardless of the direct effect of stress on BP, it is has been hypothesized that stress may be linked to adverse health behavior such as smoking, drinking, poor sleeping behaviors, medication non-adherence, all of which can cause high blood pressure (Ng & Jeffrey, 2003).

Physical activity and stress. Additional findings of interest were shown for the outcome variable of PA. The female specific models showed a significant indirect effect of stress on < mod PA in 2011 and a significant indirect effect on > PA in 2011. The male-specific models for > mod PA and < mod PA also demonstrated a significant indirect effect of stress in 2009 on > mod PA and < mod PA in 2011. While physical activity has been shown to be effective in reducing stress, less is known about the effect of high levels on stress on the outcomes of physical activity.

The results of our study provide support to demonstrate that stress may affect health by influencing physical activity patterns. In a study of Puerto Ricans living in the United States, greater perceived stress was associated with lower levels of physical activity, lower fruit and vegetable consumption, reduced protein intake, and increased consumption of salty snacks compared to those reporting lower levels of stress (Laugero, Falcon, & Tucker, 2011). In a three-month health behavior change intervention, Daubenmeir et al. (2007) found increased stress management was related to decrease in

hemoglobin A1c and triglycerides. The study also found that management of hostility and stress was associated with reductions in total cholesterol/high-density lipoprotein and weight for men. Those who increased exercise frequency and had a decrease in dietary fat reported the greatest decrease in stress compared to those who exercised less and had more dietary fat in their diet (Daubenmier et al., 2007).

Physical activity has been shown to attenuate the stress response in those with type A behaviors (Blumenthal et al., 1988; Blumenthal et al., 1999). Exercise reduces resting BP, potentially minimizing rising BP often associated with increasing levels of psychosocial stress (Barbour, Edenfield, & Blumenthal, 2007). Exercise has been demonstrated to be an effective non-pharmacological intervention to reduce BP and reduce cardiovascular risk, and is also effective in reducing stress levels (Barbour, Edenfield, & Blumenthal, 2007). High levels of chronic stress have been shown to accelerate cellular aging, but vigorous physical activity has demonstrated to have an attenuating effect on the cellular aging process (Puterman et al., 2010).

Stress and CRP. The results of our path analysis did not show that stress in 2009 had an indirect effect on CRP in 2011 for either males or females. However, stress in 2011 was associated with CRP in 2011 for our female sample. CRP was chosen as an outcome variable of interest for this analysis because chronic and acute stressful experiences or negative health behaviors have been shown to be associated with elevated levels of CRP (Kasapis & Thompson, 2005; McDade, Hawkley, & Cacioppo, 2006; Vaccarino et al., 2005) and CRP has been shown to be an active feature in the atherosclerotic process (Zwaka, Hombach, & Torzewski, 2001) and incident ischemic

heart disease (Lowe, Yarnell, Rumley, Bainton, & Sweetnam, 2001). Elevated CRP levels are a measure and indicator of the processes associated with inflammation and development of CVD (Danesh et al., 2000).

In some individuals, CRP levels can be chronically elevated (Danesh et al., 2004), which has been shown to be a useful predictor of the future development of atherosclerosis (Fahdi, Gaddam, Garza, Romeo, & Mehta, 2003) and is a risk factor for CVD (Danesh et al., 2000; Koenig, et al.,1999; Ridker, Hennekens, Buring, & Rifai, 2000). CRP has been demonstrated to be beneficial in the clinical setting to predict cardiac event outcomes and CVD (Myers et al., 2004). The Centers for Disease Control and Prevention (CDC) directed physicians to use CRP as part of a measure of global risk of CVD assessments at their discretion in 2003 (Pearson et al., 2003). Utilizing CRP assessments for patients at intermediate risk for developing CVD was recommended by the Canadian Cardiovascular Society in 2009 (Genest et al., 2009). Additionally, the 2010 AHA Task Force guidelines suggest that utilizing CRP levels is “reasonable” for intermediate risk patients (Greenland et al., 2010).

In a prospective, nested case–control study among women, CRP was shown to be more predictive of CVD when compared to 12 other common markers for CVD: serum amyloid A, soluble intercellular adhesion molecule type 1, interleukin-6, total cholesterol, LDL cholesterol, HDL cholesterol, apolipoprotein A-I, apolipoprotein B-100, Lp (a) lipoprotein, ratio of total cholesterol to HDL cholesterol, and homocysteine (Ridker, Hennekens, Buring, & Rifai, 2000). However, over the past decade, there has been an ongoing debate regarding inclusion of CRP as a valid predictor of cardiovascular events

(Kaptoge et al., 2012). CRP levels can be elevated due to trauma, or infection or in those who have been recently hospitalized (Ridker, 2003). CRP acute phase protein can be produced in response to injury or acute infection and is a common marker to indicate systemic inflammation (Danesh et al., 2004). While the benefits of using CRP as a marker for risk have gained traction in the last decade, it is still considered to be an imperfect marker of inflammation and certain limitations of using CRP must be kept in mind.

Study Limitations

As related to the HONU analysis, a limitation was found when considering the lack of the weighting of program intensity when analyzing program participation as a modifying variable between stress and the primary outcomes of interest; thus making comparisons between programs difficult. Additionally, the screening questionnaire asks respondents to quantify the frequency of programs attended, and this is limited to a total count of 12. However, program participants may have attended more than 12 programs, thus the item responses may not be an accurate indicator of total program particpation. Retrospective recall may present bias as the two year span between screenings in 2009 and 2011 may make it difficult for participants to accurately recount their attendance and particpation at various program events. A better mechanism to track program participation may be for program staff to track particpation vs. self-report. However, this may not be feasible due to program staffing limitations and tracking mechanisms. A limitation of this secondary analysis is the lack of generalizability to other more racially

diverse populations. The study sample was predominantly comprised of white individuals living in a rural mid-western town.

There are inherent issues when conducting a secondary data analysis and special consideration must be given to examine the procedures conducted in the parent study to ensure that the data collection, sampling methods and the use of the original sample population do not affect the validity of the secondary data analysis (Jacobson, Hamilton, & Galloway, 1993). A second limitation of secondary data anlysis lies in the potential discrepancy between the proposed conceptual framework of the secondary analysis to that of the original conceptual framework for the parent study.

Chapter 4—Motivational Interviewing

In our previously published manuscript included in this dissertation, we found that the use of MI in populations of African American and Latina women demonstrated that MI can be an effective technique to reduce CV risk (Witt et al., 2012). In this review, it was shown that positive effects were attained in increasing fruit and vegetable consumption, decreasing hypertension/lowering SBP, achieving weight loss goals, and improving knowledge of CVD risk modification among those receiving motivational interviewing. The findings from this review demonstrated that when using motivational interviewing cultural adaptations must be considered, and consistent techniques in the delivery and use of motivational interviewing must be consistent. While the relevant articles in this review were sparse, the promising results of MI as a technique to reduce CVD risk as shown amongst African American and Latina women may be translated to other populations as well.

A more intensive programming framework utilizing MI, specifically targeting behaviors related to physical activity and diet, have been demonstrated in multiple populations to be an effective mode of behavior change (Rubak, 2005). There is an ample body of literature that has demonstrated that MI can be effective in reducing CV risk (Thompson et al., 2011). A 2010 scientific statement from The American Heart Association confirmed that motivational interviewing (MI) has provided a strong evidence-based approach and can improve adherence to many different types of behavioral interventions, including physical activity and diet (Artinian et al., 2010).

However, careful consideration must be given to how MI is delivered. Standardization of delivery of MI has been shown to be inconsistent, thus limiting the validity of MI research that has been conducted. Additionally, the dose-effect relationship of MI must also be taken into consideration. The lack of standardization of delivery, as well as the amount of MI received also makes comparison between studies difficult (Burke, Arkowitz, & Menchola, 2003). Tailoring the message of MI to be culturally appropriate and relevant is also necessary to ensure uptake of the proposed behavior change messaging. MI has shown promise in affecting behavior change to reduce CVD risk, however, more work is needed to develop MI interventions that are delivered consistently, and tailored to the diverse target populations.

Conclusion

The results from this study provide compelling evidence that future work exploring the effects of stress on modifiable risk factors for CVD in underserved populations, particularly physical activity and blood pressure is warranted. The work

presented here demonstrate that while the effects of stress on the outcomes of interest were small, more intensive, targeted interventions with individuals experiencing elevated stress may produce more substantive effects in mediating the relationship between stress and physical activity and blood pressure. The small effect sizes found in this study may be due to in part, to the lack of intensity of the interventions delivered via HONU programming and may also be attributed to the fact that the HONU interventions did not specifically have a stress reduction component. Additionally, the results from the previously published work exploring motivational interviewing to reduce CVD risk in African American and Latina women holds promise for use in other underserved populations. The key is to deliver the intervention consistently and in a culturally appropriate manner.

Recommendations for Future Research

Behavior change programs delivered at the population level and future CVD prevention programming in settings such as New Ulm should continue to build upon the lessons learned from community based projects like HONU, MHHP, Pawtucket, and the North Karelia Project. Additionally, more work is needed to determine how to support long-lasting behavior change using techniques such as motivational interviewing and ensure that the modifiable risk factors for CVD are addressed. Targeted interventions that address stress among those experiencing the highest levels of stress may prove to have the most impact in mitigating the effect of stress on other modifiable behaviors.

As the results from behavior change interventions have demonstrated, uptake of healthy lifestyle and health promoting behaviors and adhering and maintaining those

behaviors are a universal problem, regardless of race and sex. Use of behavioral interventions such as motivational interviewing have demonstrated efficacy in supporting and sustaining positive behavior change and could be used as an adjunct component in CVD risk reduction interventions at the population level, particularly among underserved populations. Developing and implementing targeted interventions that clearly address stress reduction among those at risk for CVD is warranted.

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Appendix A. Allina Notice of Institutional Review Board Exemption Status

Allina Health IRB
2925 Chicago Avenue
Minneapolis MN
TEL: 612-262-4920
FAX: 612-262-4953

NOTICE OF APPROVAL
ALLINA HEALTH FWA NUMBER 00002425

PRINCIPAL INVESTIGATOR: Ms. Dawn Witt
IRB PROTOCOL NUMBER: 3968-1X
PROTOCOL TITLE: Effects of Stress on Physical Activity, C-Reactive Protein, and Blood Pressure
APPROVAL DATE: March 15, 2013
EXPIRATION DATE: December 31, 2999

The Allina Health Institutional Review Board (IRB) for the protection of human subjects has reviewed and approved the protocol referenced above. The items reviewed and any applicable findings specific to this approval appear in the Notes section below. Please review these notes and contact the IRB Administrative Office if you have questions concerning them.

IMPORTANT REMINDERS

CONSENT: Unless the IRB has granted a Waiver of Consent, please use a copy of the consent form with the IRB approval stamp when you are obtaining signatures for consent. (A copy of the IRB-approved consent form, bearing the Institutional Review Board [IRB] approval stamp, has been uploaded in the Attachments section. The IRB file number has also been added to the header of all consent form pages.)

ADVERSE EVENTS: Please report any local serious adverse events, unanticipated problems involving risks to subjects or others, or any serious or continuing non-compliance that occurs in relation to this study to the IRB Office within 10 business days of identification (45 CFR 46, 21 CFR 50, 56).

AMENDMENTS/MODIFICATIONS/REVISIONS: If you wish to revise any aspect of this study, you must obtain notice of IRB review and approval before implementing the proposed changes (45 CFR 46 and 21 CFR 50, 56). This requirement includes, but is not limited to, changes in any of the following: consent form(s), enrollment goal, principal investigator, sub-investigator(s), advertisements, study procedures, the investigator's brochure, or the study protocol.

CONTINUING REVIEW: This approval is valid until the protocol expiration date shown on this notice. The IRB must review and approve all non-exempt human subject research studies at intervals appropriate to the degree of risk, but not less than once per year, as required by 45 CFR 46 and 21 CFR 50, 56. In order to avoid a lapse in approval of your research, please submit your Continuing Review Form at least six weeks before the study's expiration date.

STUDY CLOSURE: If your study has been completed or terminated prior to its expiration date, please submit a Final Report to close your project. Your study file should remain open with the IRB if you are still following participants or performing data analysis.

The IRB wishes you success with your research. If you have any questions or concerns, please call the IRB administrative office at (612) 262-4920.

Yvonne Rumsey
IRB Manager

Notes:
The Allina Health Institutional Review Board administrative office has received the following items:
- IRB Exempt Application, submitted January 4, 2013
- Request for Waiver of HIPAA Authorization
- Project Proposal, dated January 4, 2013

Allina Health IRB
2925 Chicago Avenue
Minneapolis MN
TEL: 612-262-4920
FAX: 612-262-4953

Your project has met the criteria for exemption from IRB review as allowed in 45 CFR 46.101(b)(4): "Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects."

Your Request for a Waiver of HIPAA Authorization for this study was reviewed via expedited review since this research involves no more than minimal risk to the privacy of the subjects of the Protected Health Information (PHI) from whom the use is being sought. The Request for a Waiver of the HIPAA Authorization was reviewed and found to be in compliance with the HIPAA Final Rule 45 CFR 164.508.

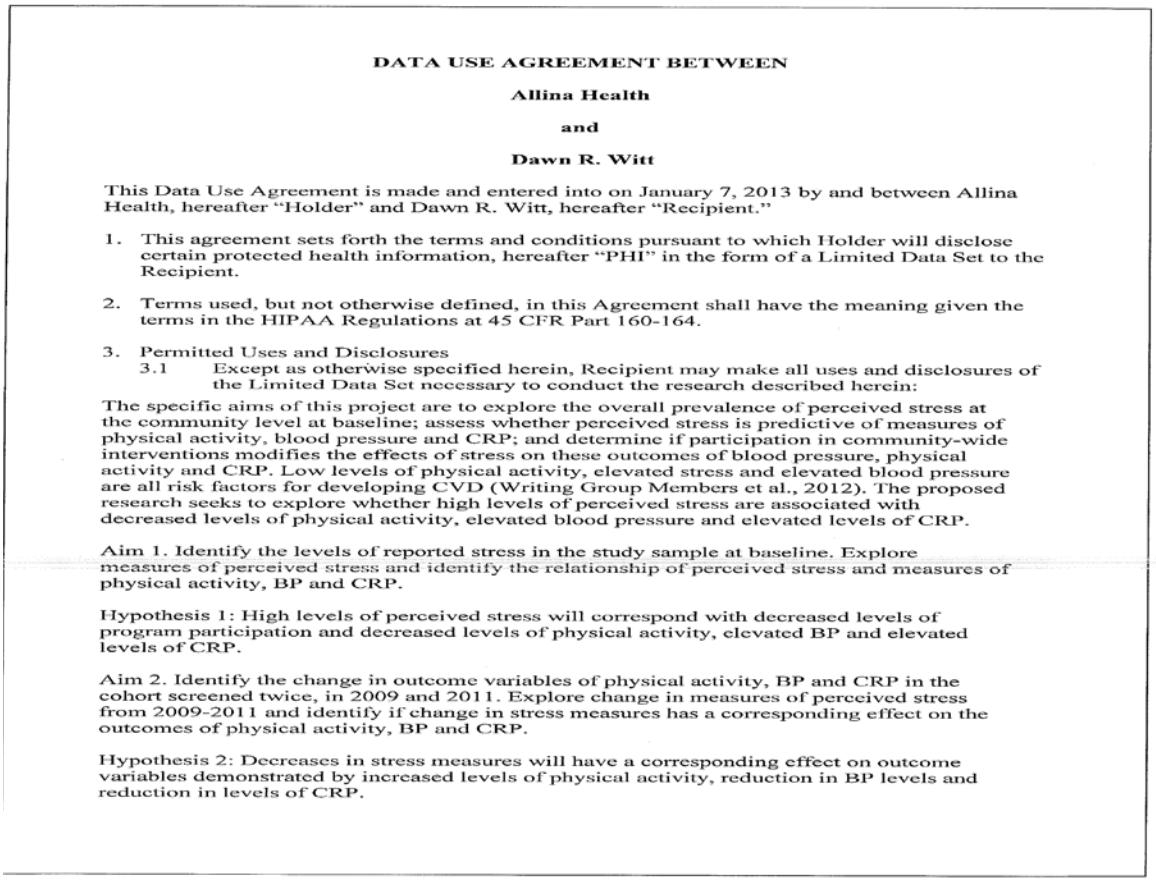
As a reminder, you may only access the minimum necessary amount of information you requested in this waiver; the waiver is limited to those elements only. Additionally, under this waiver you have the obligation to account for all disclosures of Protected Health Information (PHI) made pursuant to the above-referenced study. The purpose of this tracking is to provide patients (upon their request) with a list of how information about them was released for research and certain other non-treatment purposes without their knowledge.

You may now proceed with your project. If this project is later changed or modified in any way, please submit an Amendment Form through eProtocol for determination of continued exempt status assignment.

The entire Allina Health Institutional Review Board 1 will be notified of this exemption at their next meeting.

Thank you for your cooperation with Allina Health Institutional Review Board process. If you have any questions or concerns, please contact the IRB administrative office at (612) 262-4920.

Appendix B. Data Sharing Agreement Allina Health



DATA USE AGREEMENT BETWEEN

Allina Health

and

Dawn R. Witt

This Data Use Agreement is made and entered into on January 7, 2013 by and between Allina Health, hereafter "Holder" and Dawn R. Witt, hereafter "Recipient."

1. This agreement sets forth the terms and conditions pursuant to which Holder will disclose certain protected health information, hereafter "PHI" in the form of a Limited Data Set to the Recipient.

2. Terms used, but not otherwise defined, in this Agreement shall have the meaning given the terms in the HIPAA Regulations at 45 CFR Part 160-164.

3. Permitted Uses and Disclosures
   3.1 Except as otherwise specified herein, Recipient may make all uses and disclosures of the Limited Data Set necessary to conduct the research described herein:

The specific aims of this project are to explore the overall prevalence of perceived stress at the community level at baseline; assess whether perceived stress is predictive of measures of physical activity, blood pressure and CRP; and determine if participation in community-wide interventions modifies the effects of stress on these outcomes of blood pressure, physical activity and CRP. Low levels of physical activity, elevated stress and elevated blood pressure are all risk factors for developing CVD (Writing Group Members et al., 2012). The proposed research seeks to explore whether high levels of perceived stress are associated with decreased levels of physical activity, elevated blood pressure and elevated levels of CRP.

Aim 1. Identify the levels of reported stress in the study sample at baseline. Explore measures of perceived stress and identify the relationship of perceived stress and measures of physical activity, BP and CRP.

Hypothesis 1: High levels of perceived stress will correspond with decreased levels of program participation and decreased levels of physical activity, elevated BP and elevated levels of CRP.

Aim 2. Identify the change in outcome variables of physical activity, BP and CRP in the cohort screened twice, in 2009 and 2011. Explore change in measures of perceived stress from 2009-2011 and identify if change in stress measures has a corresponding effect on the outcomes of physical activity, BP and CRP.

Hypothesis 2: Decreases in stress measures will have a corresponding effect on outcome variables demonstrated by increased levels of physical activity, reduction in BP levels and reduction in levels of CRP.

Aim 3: Determine whether increased program participation has a modifying effect on stress and the outcome variables of BP, CRP and physical activity.

Hypothesis 3: Increased program participation will modify the effect of stress on the outcome variables as demonstrated by increased levels of physical activity, decreased BP and decreased CRP.

3.1.2

- Any publications related to the use of this data set will include an Allina or HONU team member.

3.2 In addition to the Recipient, the individuals, or classes or individuals, who are permitted to use or receive the Limited Data Set for purposes of the Research Project include: Ruth Lindquist, Diane Treat-Jacobson, Kay Savik, Linda Halcon, Jackie Boucher, and Abbey Sidebottom. To the extent that the classes of persons are not part of the Recipient's workforce who are directly involved in the Research Project, the Recipient shall enter into a data agreement with the other classes of persons before such release of the Limited Data Sets.

4. Recipient Responsibilities

4.1 Recipient will not use or disclose the Limited Data Set for any purpose other than permitted by this Agreement pertaining to the Research Project or as required by law;

4.2 Recipient will use appropriate administrative, physical and technical safeguards to prevent use or disclosure of the Limited Data Set other than as provided for by this Agreement;

4.3 Recipient will report to the Holder any use or disclosure of the Limited Data Set not provided for by this Agreement of which the Recipient becomes aware within 15 days of becoming aware of such use or disclosure;

4.4 Recipient will ensure that any agent, including a subcontractor, to whom it provides the Limited Data Set, agrees to the same restrictions and conditions that apply through this Agreement to the Recipient with respect to the Limited Data Set;

4.5 Recipient will not identify the information contained in the Limited Data Set; and

4.6 Recipient will not contact the individuals who are the subject of the PHI contained in the Limited Data Set.

5. Term and Termination

5.1 The terms of this Agreement shall be effective as of January 7, 2013, and shall remain in effect until all PHI in the Limited Data Set provided to the Recipient is destroyed or returned to the Holder.

5.2 Upon the Holder's knowledge of a material breach of this Agreement by the Recipient, the Holder shall provide an opportunity for Recipient to cure the breach or end the violation. If efforts to cure the breach or end the violation are not successful within the reasonable time period specified by the Holder, the Holder shall discontinue disclosure of PHI to the Recipient and report the problem to the Secretary of the Department of Health and Human Services or its designee. The Holder shall immediately discontinue disclosure of the Limited Data Set to the Recipient if the Holder determines cure of the breach is not possible.

6. General Provisions

6.1 Recipient and Holder understand and agree that individuals who are the subject of Protected Health Information are not intended to be third party beneficiaries of this Agreement.

6.2 This Agreement shall not be assigned by Recipient without the prior written consent of the Holder.

6.3 Each party agrees that it will be responsible for its own acts and the results thereof to the extent authorized by law and shall not be responsible for the acts of the other party or the results thereof.

IN WITNESS WHEREOF, the parties hereto execute this agreement as follows:

Allina Health

Date: 1/9/13

By: _____
(Title person with authority to sign agreement for the holder of the data)

Dawn R. Witt

Date: 1/9/13

By: _____
(Title of recipient or person with authority to sign agreement for the recipient)

Appendix C. Western Journal of Nursing Research Copyright Permission

From: Dearlove, Sandra T.
To: Dawn Witt (witt0175@umn.edu)
Subject: FW: Permissions Question: Using SAGE/WJNR Paper in Dissertation
Date: Tuesday, December 31, 2013 1:25:47 PM

Dear Dawn,

Good news! Here is clarification from SAGE that you are allowed to use your full paper in your dissertation.

Kind regards,

Sandra Dearlove, Editorial Assistant
Western Journal of Nursing Research

From: Binur, Michelle [mailto:Michelle.Binur@sagepub.com] On Behalf Of permissions (US)
Sent: Friday, December 27, 2013 5:22 PM
To: Dearlove, Sandra T.
Subject: RE: Permissions Question: Using SAGE/WJNR Paper in Dissertation

Dear Sandra,

Thank you for your request. Although it doesn't explicitly say that an author of an article may use their article in their dissertation, you can consider this email as permission to do so. Please note that this permission does not cover any 3rd party material that may be found within the work. We do ask that the source is properly cited. Please contact us for any further usage of the material.

Best regards,
Michelle Binur

From: Dearlove, Sandra T. [mailto:dearloves@missouri.edu]
Sent: Monday, December 23, 2013 2:32 PM
To: permissions (US)
Subject: Permissions Question: Using SAGE/WJNR Paper in Dissertation

Hello,

I have received a question from an author and need assistance in interpreting the contributor's publishing agreement. I am not sure if a dissertation would fall under the

author use right to “use the article (version 3) in a book you write or edit any time after publication in the journal” as described on http://www.sagepub.com/journalgateway/pubPolicies.htm#7.

This author wishes to use her entire published paper as a chapter in her dissertation, which has an estimated completion date of April 2014. Do our current permissions allow this?

The paper in question was first published on June 24, 2013. Please let me know if you need additional information.

Best regards,

Sandra Dearlove, Editorial Assistant
Western Journal of Nursing Research

Appendix D. Example of Mplus Output

```
C:\Dissertation\Mplus analysis\CRP Gender\crpfemale.out
```

```
Mplus VERSION 6
MUTHEN & MUTHEN
01/22/2014  12:36 PM

INPUT INSTRUCTIONS

  title:      FINAL Analysis  on CRP INDIRECT AND DIRECT
      data:       file is HONU_MPLUSrecodeProgsFemale.csv;
      variable:   names ID
                    Year Sex PHYS NUZip11
                    DBP11 SBP11 LDL 11 HDL_11
                    Chol 11 BMI 11 Trig 11
                    CRP 11 Glu 11 Pss T 11
                    Age 11 HX Ht 11 HX D 11
                     Cig_11  Readi 11 Adher 11
                         MedCho11 Asp_11 MedDi_11
                    MedHyp11 PATt 11
                    DBP09 SBP09 LDL_09
                    HDL 09 Chol 09
                    BMI_09 Trig_09
                     CRP 09 Glu 09
                    PSS T 09 Age 09
                    HX Ht 09 HX Di 09
                    Cig 09 Readi 09
                    Adher 09  MedCho09
                    Asp 09 MedDi 09
                    MedHyp09 PAtot_09
                    Scr09 11
                    Return only11
                    DIET CLIN WORK MdAd309
                    Strs2_09 MoPA209
                    MoPA309 LogPA09 EDUC
                     MdAd311 Strs2 11 MoPA211
                    MoPA311 LogPA11 CRP4_11
                    Ed2_09 Ed2_11;

                  usevariables are  PSS_T_09 HX_Di_09 HX_Ht_09
                  Age 09  BMI 09
                  Pss_T_11 PHYS   DIET  CLIN   WORK   EDUC  CRP_09 CRP_11;

                  missing are year-Ed2_11(999);


        model:    CRP_09  on   PSS T 09     HX_Di_09     HX_Ht_09  Age_09  BMI_09;
                       PHYS on PSS_T_09;

                    CRP_11 ON Pss_T_11 CRP_09;

                    MODEL INDIRECT:
                      CRP_11 ind  PSS_T_09;


*** WARNING in MODEL command
  Variable is uncorrelated with all other variables:  DIET
*** WARNING in MODEL command
  Variable is uncorrelated with all other variables:  CLIN
*** WARNING in MODEL command
  Variable is uncorrelated with all other variables:  WORK
*** WARNING in MODEL command
  Variable is uncorrelated with all other variables:  EDUC
*** WARNING in MODEL command
  At least one variable is uncorrelated with all other variables in the model.
```

```
Page: 1
```

```
  Check that this is what is intended.
*** WARNING
  Data set contains cases with missing on x-variables.
  These cases were not included in the analysis.
  Number of cases with missing on x-variables:  1375
   6 WARNING(S) FOUND IN THE INPUT INSTRUCTIONS


FINAL Analysis  on CRP INDIRECT AND DIRECT

SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                        1050

Number of dependent variables                                    7
Number of independent variables                                  6
Number of continuous latent variables                            0

Observed dependent variables

  Continuous
   PHYS        DIET        CLIN        WORK        EDUC        CRP_09
   CRP_11

Observed independent variables
   PSS_T_09    HX_DI_09    HX_HT_09    AGE_09      BMI_09      PSS_T_11


Estimator                                                       ML
Information matrix                                        OBSERVED
Maximum number of iterations                                 1000
Convergence criterion                                  0.500D-04
Maximum number of steepest descent iterations                  20
Maximum number of iterations for H1                          2000
Convergence criterion for H1                           0.100D-03

Input data file(s)
  HONU_MPLUSrecodeProgsFemale.csv

Input data format  FREE


SUMMARY OF DATA

     Number of missing data patterns             1


COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value   0.100


     PROPORTION OF DATA PRESENT


           Covariance Coverage
              PHYS          DIET          CLIN          WORK          EDUC
              ________      ________      ________      ________      ________
 PHYS           1.000
 DIET           1.000         1.000
 CLIN           1.000         1.000         1.000
```

WORK	1.000	1.000	1.000	1.000	
EDUC	1.000	1.000	1.000	1.000	1.000
CRP_09	1.000	1.000	1.000	1.000	1.000
CRP_11	1.000	1.000	1.000	1.000	1.000
PSS_T_09	1.000	1.000	1.000	1.000	1.000
HX_DI_09	1.000	1.000	1.000	1.000	1.000
HX_HT_09	1.000	1.000	1.000	1.000	1.000
AGE_09	1.000	1.000	1.000	1.000	1.000
BMI_09	1.000	1.000	1.000	1.000	1.000
PSS_T_11	1.000	1.000	1.000	1.000	1.000

Covariance Coverage

	CRP 09	CRP 11	PSS T 09	HX DI 09	HX HT 09
CRP_09	1.000				
CRP_11	1.000	1.000			
PSS_T_09	1.000	1.000	1.000		
HX_DI_09	1.000	1.000	1.000	1.000	
HX_HT_09	1.000	1.000	1.000	1.000	1.000
AGE_09	1.000	1.000	1.000	1.000	1.000
BMI_09	1.000	1.000	1.000	1.000	1.000
PSS_T_11	1.000	1.000	1.000	1.000	1.000

Covariance Coverage

	AGE 09	BMI 09	PSS T 11
AGE_09	1.000		
BMI_09	1.000	1.000	
PSS_T_11	1.000	1.000	1.000

THE MODEL ESTIMATION TERMINATED NORMALLY

THE STANDARD ERRORS OF THE MODEL PARAMETER ESTIMATES MAY NOT BE TRUSTWORTHY FOR SOME PARAMETERS DUE TO A NON-POSITIVE DEFINITE FIRST-ORDER DERIVATIVE PRODUCT MATRIX. THIS MAY BE DUE TO THE STARTING VALUES BUT MAY ALSO BE AN INDICATION OF MODEL NONIDENTIFICATION. THE CONDITION NUMBER IS -0.269D-15. PROBLEM INVOLVING PARAMETER 5.

THIS IS MOST LIKELY DUE TO VARIABLE PHYS BEING DICHOTOMOUS BUT DECLARED AS CONTINUOUS.

TESTS OF MODEL FIT

Chi-Square Test of Model Fit

Value	385.321
Degrees of Freedom	54
P-Value	0.0000

Chi-Square Test of Model Fit for the Baseline Model

Value	1113.239
Degrees of Freedom	63
P-Value	0.0000

CFI/TLI

```
          CFI                                0.685
          TLI                                0.632

Loglikelihood

          H0 Value                      -21033.630
          H1 Value                      -20840.970

Information Criteria

          Number of Free Parameters             23
          Akaike (AIC)                   42113.260
          Bayesian (BIC)                 42227.261
          Sample-Size Adjusted BIC       42154.209
            (n* = (n + 2) / 24)

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.076
          90 Percent C.I.                    0.069  0.084
          Probability RMSEA <= .05           0.000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.062


MODEL RESULTS

                                                                Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

 CRP 09   ON
    PSS T 09         -0.027      0.042     -0.640      0.522
    HX DI 09         -0.766      0.592     -1.294      0.196
    HX HT 09          1.118      0.623      1.795      0.073
    AGE 09           -0.032      0.009     -3.436      0.001
    BMI_09            0.273      0.020     13.550      0.000

 PHYS     ON
    PSS_T_09          0.001      0.005      0.288      0.773

 CRP 11   ON
    PSS T 11          0.089      0.038      2.363      0.018
    CRP_09            0.620      0.024     26.290      0.000

 CRP 11   WITH
    PHYS             -0.013      0.048     -0.265      0.791

 Means
    DIET              0.326      0.014     22.521      0.000
    CLIN              0.253      0.013     18.875      0.000
    WORK              0.211      0.013     16.779      0.000
    EDUC              0.737      0.014     54.264      0.000

 Intercepts
    PHYS              0.335      0.024     13.692      0.000
    CRP 09           -2.629      0.775     -3.391      0.001
    CRP_11            0.743      0.178      4.166      0.000

 Variances
```

DIET	0.220	0.010	22.913	0.000
CLIN	0.189	0.008	22.913	0.000
WORK	0.167	0.007	22.913	0.000
EDUC	0.194	0.008	22.913	0.000
Residual Variances				
PHYS	0.225	0.010	22.913	0.000
CRP 09	15.614	0.681	22.913	0.000
CRP_11	10.796	0.471	22.912	0.000

QUALITY OF NUMERICAL RESULTS

Condition Number for the Information Matrix 0.928E-05
(ratio of smallest to largest eigenvalue)

TOTAL, TOTAL INDIRECT, SPECIFIC INDIRECT, AND DIRECT EFFECTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Effects from PSS_T_09 to CRP_11				
Total	-0.017	0.026	-0.640	0.522
Total indirect	-0.017	0.026	-0.640	0.522
Specific indirect				
CRP_11				
CRP_09				
PSS_T_09	-0.017	0.026	-0.640	0.522

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION

	NU PHYS	DIET	CLIN	WORK	EDUC
1	0	1	2	3	4

	NU CRP 09	CRP 11	PSS T 09	HX DI 09	HX HT 09
1	0	0	0	0	0

	NU AGE 09	BMI 09	PSS T 11
1	0	0	0

	LAMBDA PHYS	CRP_09	CRP_11	PSS_T_09	HX_DI_09

PHYS	0	0	0	0	0
DIET	0	0	0	0	0
CLIN	0	0	0	0	0
WORK	0	0	0	0	0
EDUC	0	0	0	0	0
CRP_09	0	0	0	0	0
CRP_11	0	0	0	0	0
PSS_T_09	0	0	0	0	0
HX_DI_09	0	0	0	0	0
HX_HT_09	0	0	0	0	0
AGE_09	0	0	0	0	0
BMI_09	0	0	0	0	0
PSS_T_11	0	0	0	0	0

LAMBDA

	HX_HT_09	AGE_09	BMI_09	PSS_T_11
PHYS	0	0	0	0
DIET	0	0	0	0
CLIN	0	0	0	0
WORK	0	0	0	0
EDUC	0	0	0	0
CRP_09	0	0	0	0
CRP_11	0	0	0	0
PSS_T_09	0	0	0	0
HX_DI_09	0	0	0	0
HX_HT_09	0	0	0	0
AGE_09	0	0	0	0
BMI_09	0	0	0	0
PSS_T_11	0	0	0	0

THETA

	PHYS	DIET	CLIN	WORK	EDUC
PHYS	0				
DIET	0	5			
CLIN	0	0	6		
WORK	0	0	0	7	
EDUC	0	0	0	0	8
CRP_09	0	0	0	0	0
CRP_11	0	0	0	0	0
PSS_T_09	0	0	0	0	0
HX_DI_09	0	0	0	0	0
HX_HT_09	0	0	0	0	0
AGE_09	0	0	0	0	0
BMI_09	0	0	0	0	0
PSS_T_11	0	0	0	0	0

THETA

	CRP_09	CRP_11	PSS_T_09	HX_DI_09	HX_HT_09
CRP_09	0				
CRP_11	0	0			
PSS_T_09	0	0	0		
HX_DI_09	0	0	0	0	
HX_HT_09	0	0	0	0	0
AGE_09	0	0	0	0	0
BMI_09	0	0	0	0	0
PSS_T_11	0	0	0	0	0

THETA

	AGE 09	BMI 09	PSS T 11
AGE 09	0		
BMI 09	0	0	
PSS_T_11	0	0	0

ALPHA

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
1	9	10	11	0	0

ALPHA

	HX HT 09	AGE 09	BMI 09	PSS T 11
1	0	0	0	0

BETA

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
PHYS	0	0	0	12	0
CRP 09	0	0	0	13	14
CRP 11	0	18	0	0	0
PSS T 09	0	0	0	0	0
HX_DI_09	0	0	0	0	0
HX HT 09	0	0	0	0	0
AGE 09	0	0	0	0	0
BMI 09	0	0	0	0	0
PSS_T_11	0	0	0	0	0

BETA

	HX HT 09	AGE 09	BMI 09	PSS T 11
PHYS	0	0	0	0
CRP_09	15	16	17	0
CRP 11	0	0	0	19
PSS_T_09	0	0	0	0
HX DI 09	0	0	0	0
HX HT 09	0	0	0	0
AGE 09	0	0	0	0
BMI 09	0	0	0	0
PSS_T_11	0	0	0	0

PSI

	PHYS	CRP_09	CRP_11	PSS_T_09	HX_DI_09
PHYS	20				
CRP 09	0	21			
CRP 11	22	0	23		
PSS T 09	0	0	0	0	
HX DI 09	0	0	0	0	0
HX HT 09	0	0	0	0	0
AGE 09	0	0	0	0	0
BMI 09	0	0	0	0	0
PSS_T_11	0	0	0	0	0

PSI

	HX HT 09	AGE 09	BMI 09	PSS T 11
HX HT 09	0			
AGE 09	0	0		
BMI 09	0	0	0	
PSS_T_11	0	0	0	0

STARTING VALUES

NU

	PHYS	DIET	CLIN	WORK	EDUC
1	0.000	0.000	0.000	0.000	0.000

NU

	CRP_09	CRP_11	PSS_T_09	HX_DI_09	HX_HT_09
1	0.000	0.000	0.000	0.000	0.000

NU

	AGE 09	BMI 09	PSS T 11
1	0.000	0.000	0.000

LAMBDA

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
PHYS	1.000	0.000	0.000	0.000	0.000
DIET	0.000	0.000	0.000	0.000	0.000
CLIN	0.000	0.000	0.000	0.000	0.000
WORK	0.000	0.000	0.000	0.000	0.000
EDUC	0.000	0.000	0.000	0.000	0.000
CRP 09	0.000	1.000	0.000	0.000	0.000
CRP_11	0.000	0.000	1.000	0.000	0.000
PSS T 09	0.000	0.000	0.000	1.000	0.000
HX_DI_09	0.000	0.000	0.000	0.000	1.000
HX HT 09	0.000	0.000	0.000	0.000	0.000
AGE 09	0.000	0.000	0.000	0.000	0.000
BMI 09	0.000	0.000	0.000	0.000	0.000
PSS_T_11	0.000	0.000	0.000	0.000	0.000

LAMBDA

	HX HT 09	AGE 09	BMI 09	PSS T 11
PHYS	0.000	0.000	0.000	0.000
DIET	0.000	0.000	0.000	0.000
CLIN	0.000	0.000	0.000	0.000
WORK	0.000	0.000	0.000	0.000
EDUC	0.000	0.000	0.000	0.000
CRP 09	0.000	0.000	0.000	0.000
CRP 11	0.000	0.000	0.000	0.000
PSS T 09	0.000	0.000	0.000	0.000
HX DI 09	0.000	0.000	0.000	0.000
HX HT 09	1.000	0.000	0.000	0.000
AGE_09	0.000	1.000	0.000	0.000
BMI_09	0.000	0.000	1.000	0.000

PSS_T_11	0.000	0.000	0.000	1.000	

THETA

	PHYS	DIET	CLIN	WORK	EDUC
PHYS	0.000				
DIET	0.000	0.110			
CLIN	0.000	0.000	0.095		
WORK	0.000	0.000	0.000	0.083	
EDUC	0.000	0.000	0.000	0.000	0.097
CRP 09	0.000	0.000	0.000	0.000	0.000
CRP 11	0.000	0.000	0.000	0.000	0.000
PSS T 09	0.000	0.000	0.000	0.000	0.000
HX DI 09	0.000	0.000	0.000	0.000	0.000
HX HT 09	0.000	0.000	0.000	0.000	0.000
AGE 09	0.000	0.000	0.000	0.000	0.000
BMI_09	0.000	0.000	0.000	0.000	0.000
PSS_T_11	0.000	0.000	0.000	0.000	0.000

THETA

	CRP 09	CRP 11	PSS T 09	HX DI 09	HX HT 09
CRP 09	0.000				
CRP 11	0.000	0.000			
PSS T 09	0.000	0.000	0.000		
HX DI 09	0.000	0.000	0.000	0.000	
HX_HT_09	0.000	0.000	0.000	0.000	0.000
AGE 09	0.000	0.000	0.000	0.000	0.000
BMI_09	0.000	0.000	0.000	0.000	0.000
PSS_T_11	0.000	0.000	0.000	0.000	0.000

THETA

	AGE 09	BMI 09	PSS T 11
AGE 09	0.000		
BMI 09	0.000	0.000	
PSS_T_11	0.000	0.000	0.000

ALPHA

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
1	0.341	3.393	3.151	3.926	0.048

ALPHA

	HX HT 09	AGE 09	BMI 09	PSS T 11
1	0.043	52.556	28.565	3.413

BETA

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
PHYS	0.000	0.000	0.000	0.000	0.000
CRP 09	0.000	0.000	0.000	0.000	0.000
CRP 11	0.000	0.000	0.000	0.000	0.000
PSS T 09	0.000	0.000	0.000	0.000	0.000
HX_DI_09	0.000	0.000	0.000	0.000	0.000
HX_HT_09	0.000	0.000	0.000	0.000	0.000

AGE 09	0.000	0.000	0.000	0.000	0.000
BMI 09	0.000	0.000	0.000	0.000	0.000
PSS_T_11	0.000	0.000	0.000	0.000	0.000

BETA

	HX_HT_09	AGE_09	BMI_09	PSS_T_11
PHYS	0.000	0.000	0.000	0.000
CRP 09	0.000	0.000	0.000	0.000
CRP 11	0.000	0.000	0.000	0.000
PSS T 09	0.000	0.000	0.000	0.000
HX DI 09	0.000	0.000	0.000	0.000
HX HT 09	0.000	0.000	0.000	0.000
AGE 09	0.000	0.000	0.000	0.000
BMI 09	0.000	0.000	0.000	0.000
PSS_T_11	0.000	0.000	0.000	0.000

PSI

	PHYS	CRP 09	CRP 11	PSS T 09	HX DI 09
PHYS	0.112				
CRP 09	0.000	9.317			
CRP 11	0.000	0.000	9.063		
PSS T 09	0.000	0.000	0.000	8.558	
HX DI 09	0.000	0.000	0.000	-0.012	0.045
HX HT 09	0.000	0.000	0.000	-0.008	0.007
AGE 09	0.000	0.000	0.000	-5.832	0.183
BMI 09	0.000	0.000	0.000	1.434	0.282
PSS_T_11	0.000	0.000	0.000	4.463	0.002

PSI

	HX HT 09	AGE 09	BMI 09	PSS T 11
HX HT 09	0.041			
AGE 09	0.567	182.757		
BMI 09	0.115	2.253	38.777	
PSS_T_11	0.015	-3.034	2.366	7.223

Beginning Time: 12:36:04
Ending Time: 12:36:05
Elapsed Time: 00:00:01

MUTHEN & MUTHEN
3463 Stoner Ave.
Los Angeles, CA 90066

Tel: (310) 391-9971
Fax: (310) 391-8971
Web: www.StatModel.com
Support: Support@StatModel.com

Appendix E. HONU 2011 Screening Questionnaire

Affix label here

heartsbeatback
THE HEART OF NEW ULM PROJECT

Heart of New Ulm Project – Screening Assessment

Directions: Use pencil. X the circle next to the response that best answers each question below. Unless otherwise indicated, only select one response per question. If you change a response, please erase thoroughly. Note that there is a space at the end of the survey if you wish to add any comments. If an item does not apply to you or if you do not know the answer (or just do not want to answer it), select the "Don't know or choose no answer" option. If you have any questions or concerns, ask for assistance.

1. What is your **sex**?
   - ○ Male
   - ○ Female
   - ○ Don't know or choose no answer

2. What best describes your **racial/ethnic** background?

   (Pick all responses that apply.)
   - ○ White
   - ○ American Indian or Alaska Native
   - ○ Asian
   - ○ Black or African American
   - ○ Hispanic or Latino
   - ○ Native Hawaiian or Pacific Islander
   - ○ Other
   - ○ Don't know or choose no answer

3. What is the highest level of **education** that you have completed?
   - ○ 8th grade or less
   - ○ Some high school
   - ○ High school diploma or GED
   - ○ Some college
   - ○ Technical degree or certificate
   - ○ Associate degree
   - ○ Bachelor's degree
   - ○ Master's degree
   - ○ Doctoral or Professional degree
   - ○ Don't know or choose no answer

4. Do you have any kind of **health care coverage**, including health insurance, prepaid plan, HMO, or a government plan such as Medicare?

- ○ Yes
- ○ No
- ○ Don't know or choose no answer

---

5. Did your **mother or father** have any of the following health conditions?

(Pick all responses that apply.)

- ○ Heart attack before age 60
- ○ Diabetes
- ○ None of the above
- ○ Don't know or choose no answer

---

6. Has a healthcare provider ever told you that **you** have any of the following health conditions?

(Pick all responses that apply.)

- ○ Type 1 diabetes
- ○ Type 2 diabetes
- ○ Pre-diabetes
- ○ Other diabetes (such as during pregnancy)
- ○ High blood pressure
- ○ High cholesterol
- ○ Depression
- ○ Low vitamin D
- ○ Stroke
- ○ Heart attack
- ○ Angina
- ○ Atrial fibrillation
- ○ Left ventricular hypertrophy
- ○ Congestive heart failure
- ○ Other heart disease – add details in box to left
- ○ None of the above
- ○ Don't know or choose no answer

"Other heart disease" explanation

---

7. Do you **smoke cigarettes**?

- ○ Yes
- ○ No, I quit
- ○ No, I have never smoked
- ○ Don't know or choose no answer

8. How often are you **around someone else's tobacco smoke**?

- ○ Daily
- ○ Most days of the week
- ○ Some days of the week
- ○ Rarely or never
- ○ Don't know or choose no answer

---

9. In a typical week, how many **drinks containing alcohol** do you have?

(One alcoholic drink is equal to one can/bottle of beer, one glass of wine, one mixed drink, or one shot of hard liquor.)

- ○ 0
- ○ 1-7
- ○ 8-14
- ○ 15 or more
- ○ Don't know or choose no answer

---

10. How often do you take **aspirin**?

- ○ Daily
- ○ Every other day
- ○ Weekly
- ○ Less than weekly
- ○ Don't know or choose no answer

---

11. Do you have a prescription to take **medication** for any of the following health conditions?

(Pick all responses that apply.)

- ○ Diabetes
- ○ High blood pressure
- ○ High cholesterol
- ○ None of the above
- ○ Don't know or choose no answer

---

12. If 100% is all of the time and 0% is not at all, over the past month, **how much of the time** have you taken all of your prescribed medications indicated in question 11 above?

- ○ 0%
- ○ 1-9%
- ○ 10-19%
- ○ 20-29%
- ○ 30-39%
- ○ 40-49%
- ○ 50-59%
- ○ 60-69%
- ○ 70-79%
- ○ 80-89%
- ○ 90-99%
- ○ 100%
- ○ Not prescribed medications above
- ○ Don't know or choose no answer

13. How many **days** in a typical week do you do **vigorous physical activities** for at least 10 minutes at a time?

(Vigorous physical activities refer to activities that take hard effort and make your heart rate and breathing much harder than normal. They include things like heavy lifting, digging, aerobic exercise, jogging, or bicycling at a fast pace.)

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ Don't know or choose no answer

---

14. How many **minutes** do you usually spend doing **vigorous physical activities** on any one of those days?

- ○ 0
- ○ 1-9
- ○ 10-19
- ○ 20-29
- ○ 30-39
- ○ 40-49
- ○ 50-59
- ○ 60-69
- ○ 70-79
- ○ 80-89
- ○ 90-99
- ○ 100-109
- ○ 110-119
- ○ 120 or more
- ○ I do not do vigorous activities
- ○ Don't know or choose no answer

---

15. How many **days** in a typical week do you do **moderate physical activities** for at least 10 minutes at a time?

(Moderate physical activities refer to activities that take modest effort and make you breathe somewhat harder than normal. They include things like brisk walking, carrying light loads, vacuuming, gardening, dancing, or bicycling at a regular pace.)

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ Don't know or choose no answer

---

16. How many **minutes** do you usually spend doing **moderate physical activities** on any one of those days?

- ○ 0
- ○ 1-9
- ○ 10-19
- ○ 20-29
- ○ 30-39
- ○ 40-49
- ○ 50-59
- ○ 60-69
- ○ 70-79
- ○ 80-89
- ○ 90-99
- ○ 100-109
- ○ 110-119
- ○ 120 or more
- ○ I do not do moderate activities
- ○ Don't know or choose no answer

17. How many servings of **fruits and vegetables** do you usually eat each day?

(A serving is 1 piece of fruit, ½ cup of fruit or cooked vegetables, 1 cup of raw leafy vegetables, or ¾ cup of juice.)

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12 or more
- ○ Don't know or choose no answer

---

18. Overall, would you say your diet is high, moderate, or low in **fat**?

- ○ High
- ○ Moderate
- ○ Low
- ○ Don't know or choose no answer

---

19. In the last month, how often have you felt that you were **unable to control the important things in your life**?

- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often
- ○ Don't know or choose no answer

---

20. In the last month, how often have you felt **confident about your ability to handle your personal problems?**

- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often
- ○ Don't know or choose no answer

---

21. In the last month, how often have you felt that **things were going your way?**

- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often
- ○ Don't know or choose no answer

22. In the last month, how often have you felt **difficulties were piling up so high that you could not overcome them**?

- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often
- ○ Don't know or choose no answer

---

23. Do you **intend to improve your lifestyle habits** over the next 6 months?

(For example, are you planning to eat healthier, quit smoking, or become more physically active soon?)

- ○ No, I do not need to or do not want to
- ○ Maybe, I'm thinking about it
- ○ Yes
- ○ Don't know or choose no answer

---

24. Are you currently **employed** (i.e., working for pay)?

- ○ No → skip to question 29
- ○ Yes

---

25. During the past 7 days, how many **hours did you miss from work because of your health problems**?

(Include hours you missed on sick days, times you went in late, left early, etc., because of your health problems.)

- ○ 0
- ○ 1-3
- ○ 4-6
- ○ 7-9
- ○ 10-12
- ○ 13-15
- ○ 16-18
- ○ 19-21
- ○ 22-24
- ○ 25-27
- ○ 28-30
- ○ 31-33
- ○ 34-36
- ○ 37-39
- ○ 40 or more
- ○ Don't know or choose no answer

---

26. During the past 7 days, how many **hours did you miss from work because of any other reason**, such as vacation, holidays, or time off?

- ○ 0
- ○ 1-3
- ○ 4-6
- ○ 7-9
- ○ 10-12
- ○ 13-15
- ○ 16-18
- ○ 19-21
- ○ 22-24
- ○ 25-27
- ○ 28-30
- ○ 31-33
- ○ 34-36
- ○ 37-39
- ○ 40 or more
- ○ Don't know or choose no answer

27. During the past 7 days, how many **hours did you actually work**?

- ○ 0
- ○ 1-3
- ○ 4-6
- ○ 7-9
- ○ 10-12
- ○ 13-15
- ○ 16-18
- ○ 19-21
- ○ 22-24
- ○ 25-27
- ○ 28-30
- ○ 31-33
- ○ 34-36
- ○ 37-39
- ○ 40 or more
- ○ Don't know or choose no answer

---

28. During the past 7 days, how much did your **health problems affect your productivity** while you were working? Rate your productivity on a scale from 0 (no effect on work) to 10 (completely prevented work).

(Think about days you were limited in the amount of work you could do, days you accomplished less than you would like, or days you could not do your work as carefully as usual.)

- ○ 0 No effect on work
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 Completely prevented work
- ○ Don't know or choose no answer

---

29. Overall, how satisfied are you with what the Hearts Beat Back: The Heart of New Ulm Project is doing in this community?

- ○ Very satisfied
- ○ Satisfied
- ○ Neutral
- ○ Somewhat dissatisfied
- ○ Very dissatisfied
- ○ Don't know or choose no answer

30. Over the past year, have you participated in any of the following Hearts Beat Back: The Heart of New Ulm Project programs or services? *(Pick all responses that apply.)*

- ○ Participated in the Take Five Community Health Challenge (e.g., used tracking log)
- ○ Used a Heart Health Station to measure weight or blood pressure
- ○ Participated in a grocery store tour
- ○ Engaged in a worksite program to improve my health
- ○ Attended a cooking class
- ○ Watched "What's Cooking New Ulm?" television show
- ○ Visited heartsbeatback.org website
- ○ Participated in a neighborhood lifestyle program (e.g., Belly dancing, Dance Your Heart Out, etc.)
- ○ Attended a neighborhood healthy potluck
- ○ Attended a walking club event
- ○ Received a phone call to participate in phone coaching to reduce my risk of a heart attack
- ○ Received the Heart of New Ulm Project e-newsletter or read the newsletter in the New Ulm Journal
- ○ Other – provide details in the box below
- ○ I have not participated in any of the Heart of New Ulm Project programs or services

"Other" explanation

31. Comments or concerns?

Thank you. Please return this survey to a staff member. Do not write beyond this line.

Affix label here

Medical Record Number

○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1	○ 1
○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2	○ 2
○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3	○ 3
○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4	○ 4
○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5	○ 5
○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6	○ 6
○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7	○ 7
○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8	○ 8
○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9	○ 9

Age (years)

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Fasting

- ○ 12 hours or more
- ○ 8-11 hours
- ○ Less than 8 hours

Blood Draw Consent

○ Yes
○ No

Blood pressure #1

Systolic (mm/Hg) ___ ___ ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Diastolic (mm/Hg) ___ ___ ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Blood pressure #2

Systolic (mm/Hg) ___ ___ ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Diastolic (mm/Hg) ___ ___ ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Height (inches) ___ ___ • ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9

Weight (pounds) ___ ___ ___ • ___

○ 0	○ 0	○ 0	○ 0
○ 1	○ 1	○ 1	○ 1
○ 2	○ 2	○ 2	○ 2
○ 3	○ 3	○ 3	○ 3
○ 4	○ 4	○ 4	○ 4
○ 5	○ 5	○ 5	○ 5
○ 6	○ 6	○ 6	○ 6
○ 7	○ 7	○ 7	○ 7
○ 8	○ 8	○ 8	○ 8
○ 9	○ 9	○ 9	○ 9

Waist circumference (inches) ___ ___ • ___

○ 0	○ 0	○ 0
○ 1	○ 1	○ 1
○ 2	○ 2	○ 2
○ 3	○ 3	○ 3
○ 4	○ 4	○ 4
○ 5	○ 5	○ 5
○ 6	○ 6	○ 6
○ 7	○ 7	○ 7
○ 8	○ 8	○ 8
○ 9	○ 9	○ 9